APPENDIX 2C-1

July 2005 Consolidated Pre-Meeting Comments

Peer Review of Proposed Air and Other Relevant Indicators for EPA's 2006 Report on the Environment

July 21, 2005

Notice:

Pre-meeting comments were prepared by each consultant individually prior to the meeting. They are preliminary comments only, and are used to help consultants become familiar with the document and charge questions, develop the agenda, and identify key issues for discussion. During the meeting, consultants may expand on or change opinions expressed in their pre-meeting remarks and may introduce additional issues. For these reasons, pre-meeting comments should be regarded as preliminary and do not reflect the final conclusions and recommendations of individual consultants. These pre-meeting comments will be included as an appendix in the meeting summary report, along with other background materials.

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Air Reviewer Biographies

Lyle Chinkin
Sonoma Technology, Inc.

Mr. Lyle Chinkin is a Senior Vice President for Sonoma Technology, Inc. (STI), where he manages the Emissions, Policy, and Geographic Information Systems (GIS) Services Division; he also serves as STI's corporate General Manager. He has over 25 years of professional air quality experience and began his career at the California Air Resources Board.

Mr. Chinkin is a nationally recognized expert in emission inventory preparation and assessment and air quality analysis. His clients include federal, state, and local government agencies; universities; public and private research consortiums; and major corporations. Mr. Chinkin's areas of expertise include (1) developing and improving regional emission inventories; (2) providing independent assessments of emission inventories using bottom-up and top-down evaluation techniques; (3) conducting field studies to obtain real-world data and improve activity estimates and emission factors; (4) conducting scoping study studies to develop conceptual models of community-scale air quality; (5) assisting with State Implementation Plan (SIP) development; and (6) providing expert testimony and presentations to public boards. He has been appointed to the National Research Council of the National Academy of Sciences Committee on the Effects of Changes in New Source Review Programs for Stationary Sources of Air Pollutants, and a panel to review "Improving Emission Inventories for Effective Air Quality Management Across North America, a NARSTO Assessment" (2005).

Mr. Chinkin served as (1) an EPA-invited peer-reviewer of the EPA particulate matter (PM) National Ambient Air Quality Standards Criteria Document; (2) an expert panel member for the review of the Valdez Air Health Study; and (3) an expert witness for the U.S. Department of Justice in its case involving heavy-duty diesel engine manufacturers. Mr. Chinkin was the project manager and co-author of the EPA national guidance document on the preparation of emission inputs for photochemical air quality simulation models. In addition, his research projects have included improving estimates of PM and ammonia emissions, evaluating internal-combustion-engine activity profiles and emissions, determining emissions from propane use and distribution systems, determining air toxic emissions from wood-preservation activities; and improving biogenic emission estimation tools. He frequently directs studies that involve public- and private-sector participation (e.g., an assessment and ground-truth study of industrial emissions in the Houston Ship Channel under the joint direction of the Texas Natural Resource Conservation Commission [now Texas Commission on Environmental Quality] and local industry).

Mr. Chinkin is frequently called upon by clients to help explain complicated technical information to other air quality professionals, advisory boards, and members of the public. He presented research findings to public advisory committees in Ohio, Kansas, and Missouri and senior federal and state government officials in Minnesota and at numerous scientific conferences. EPA selected Mr. Chinkin to help prepare a summary of the proceedings of the 2003 NARSTO air quality research conference, and to help an audience of air quality officials from four western U.S. states understand technical air toxics assessment techniques.

Kevin Civerolo
New York State Department of Environmental Conservation
Division of Air Resources

Kevin Civerolo has been a research scientist with the New York State Department of Environmental Conservation Division of Air Resources since 1998. Dr. Civerolo's primary task is to provide technical support for the state planning process for ozone, fine particulates, and mercury. His professional interests also include the evaluation of meteorological and photochemical models; estimating the effects of land use change and large-scale tree planting on air quality; analysis of spatial and temporal trends in air and water pollution data using traditional and non-traditional methods; and back trajectory and source attribution analysis. Dr. Civerolo also has experience in the development and use of several techniques for monitoring ambient reactive nitrogen compounds. He currently is an adjunct assistant professor at the University at Albany School of Public Health. His M.S. and Ph.D. degrees in Meteorology were awarded by the University of Maryland in 1993 and 1996, respectively.

David Fairley
Bay Area Air Quality Management District

David Fairley received his Ph.D. in statistics from Stanford University in 1982. After teaching in the Ohio State University Statistics Department for five years, he returned to San Francisco to become the Bay Area Air Quality Management District's statistician. His regular duties there include analyzing air quality trends and progress relative toward meeting national and California air quality standards, helping to design and analyze research projects carried out by the district, and serving as the district's in-house statistical consultant.

His recent studies include an analysis of the sources of PM2.5 in the Bay Area, and the representativeness of ozone episodes used for photochemical modeling. Publications include an analysis of the stability of the ozone standards and a method for improving them (AWMA's EM Magazine, 2/99) (http://www.awma.org/em/99/Feb99/features/fairley/fairley.htm); an analysis of the nominal vs. actual level of the 8-hour ozone standard; a paper on improving a technique used in photochemical modeling qc analysis; and an analysis of the spatial distribution of the ozone weekend effect in California. His analysis of mortality and air pollutants in Santa Clara, California, was among those used by EPA staff to develop their proposal for revised PM standards. (http://www.epa.gov:80/ttn/naaqs/standards/pm/s_pm_cr_sp.html)

George Hidy
Envair/Aerochem

Dr. George M. Hidy is an internationally known atmospheric scientist with over 40 years of experience in research relevant to air quality management and the environmental issues associated with energy production and use. Dr. Hidy is trained as a chemical engineer, and has served in a number of industrial and academic positions in which he has led investigations on Criteria Pollutant characterization, and airborne toxic chemicals.

Dr. Hidy has been an advisor to the Environmental Protection Agency, serving as a member of the Science Advisory Board Engineering Committee, and the Executive Committee. He also has been a

reviewer of a number of EPA proposals and reports, particularly for the Office of Research and Development. He has served on a number of National Research Council committees on environmental chemistry and energy related technologies. Dr. Hidy's current interests include airborne particles, both in terms of the National Ambient Air Quality standards, and in terms of visibility impairment. He also has been active in NARSTO in preparation of its ozone and particulate matter state-of-science assessments, as well as its emission inventory assessment. With his colleagues, Dr. Hidy recent completed a major review integrating atmospheric chemistry with the toxicology and epidemiology of particulate matter. He is also involved in extending knowledge of secondary particle formation, especially airborne nitrate and carbon, in relation to their origins and ambient concentration reductions.

Comments for Group 1 Indicators

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Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **PM Emissions**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3) Missing contributions from prescribed and wildfire emissions. Both are required for NEI and air quality planning modeling exercises and should be readily available.

Civerolo: (3) These emissions are important for photochemical modeling and source apportionment, and thus are useful in characterizing urban air quality.

Fairley: (3) The indicator itself is AA&U, but the implementation could be improved as explained below.

Hidy: (3) This emissions indicator is appropriate and useful to gain insight about primary PM10 and PM2.5 emissions, but is not adequate as a metric for ROE. There are major uncertainties in both the PM10 and PM2.5 inventories, which result from inadequate knowledge about fugitive emissions (PMx), transportation sources relating to real world fleets. The inventories are changing with improved data, and methodology; the estimated trends are likely to change with inventory changes. The uncertainties are likely to be large enough in error and bias by year to mask the actual trends.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) PM has proven health effects on sensitive populations.

Civerolo: (3) I'd actually rank it about 2.5. It is a contributor to urban/local pollution, but is not as important as SO_2 or NO_x on more regional scales. It might help to include a brief discussion of what the composition of primary particulates is – crustal material, carbon/soot, etc.

Fairley: (3) Although there is another indicator showing ambient PM10 trends, this indicator has the value of showing what the major sources are of direct PM10 emissions.

Hidy: (3) If the inventory were reliable it represents an important measure of change in particle emissions, which are of interest to the public.

3) To what extent do you think the indicator meets the following indicator definition:

> *An "indicator" is* ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (2) Emission inventories except for a few pollutants from large point sources (e.g. power plants) are calculations based on a variety of estimated inputs; not direct measurements.

Civerolo: (2) Since the methodology of estimating emissions changed in 1999, it is difficult to interpret trends or changes over time. Comparing the difference between values at two points in time – 1990 and 2002, as is done here – does not necessarily describe how the emissions have really changed over the intervening years.

Fairley: (1) Emissions estimates are mostly made from engineering calculations, not "actual measurements." So, it doesn't fit the indicator definition. However, I emissions estimates are still highly useful, that is, the fact these are generally not measurements doesn't invalidate them.

Hidy: (2) Both are based on limited emission data from certain important source categories. In the case of PM10, road dust and other fugitive sources are important contributors and difficult to quantify. In the case of PM2.5, the carbon emissions are important for PM2.5 mass and are very uncertain for most sources. Motor vehicle emissions for the real world fleet are calculated from models, and are uncertain. There are problems in sampling to account for condensables and semivolatile material; this area remains ill defined, but is a major uncertainty in reporting emissions.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (3)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (2)
Hidy: (2)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (2)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (2)
Hidy: (2)

e) The data are comparable across time and space, and representative[1] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

[1] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (2)
Hidy: (2)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (2)
Hidy: (2)

Please explain:

Chinkin: Different agencies contribute to the NEI and use locally developed procedures and emissions estimation methods in some cases.

Civerolo: Estimating these emissions on an annual basis is difficult, but I would hope that they are generated on a fairly consistent basis from state to state, source category to source category, etc. However, it does not appear that there is consistency through time, as condensables were added in 1999. I would feel more comfortable with this indicator knowing that even if estimates are highly uncertain, the same methods were used throughout the period of interest. It might help to list some of the other methodology changes as well.

Fairley: The fact that condensable matter was added in 1999 obscured the underlying trend. Either it should be removed, or shown with a separate color.

Hidy: The PMx emissions are important, but equally as important are the secondary PM precursors for accounting for PM in the atmosphere.
There are problems in the measurement of certain sources that have large quantities of organics or semi-volatiles, which need to be resolved, and the inventories corrected for a uniform definition. As noted, the uncertainties in the estimates are likely to be larger than the trends reported. Particularly for PM2.5, systematic sampling, especially for carbonaceous emitters needs to be done much more extensively to insure reliability. Currently the data are not comparable in time or space, but are based on varying emission factors from those that date to the 1970s forward till today. The results are not transparent or reproducible based on current estimator methods.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Recommend start graphs at 1996 or fix data gap between 1990 and 1996. Recommend using different symbols and colors on line plots to better distinguish information.

Civerolo: Since the methods of estimating emissions changed in 1999, it might be useful to only plot the data since then. Otherwise, is it possible to either remove the condensable fraction after 1999, or add a condensable fraction to the data prior to 1999? I am assuming that this is one of the more substantial changes to the methodology. If this is not the case, then listing other substantial changes to the estimation methods would be useful to the reader.

Fairley: The graphs 008b-1 and 008b-2 are very confusing for two reasons. One is the exclusion of some years, but the inclusion of a discontinuity where "condensables" are added in1999. The second is the categories of "fuel combustion" alongside "on-road vehicles" and "non-road vehicles and engines." An alternative would be a bar chart comparing 1990 with the most recent year available (2002 or 2003), but with a much finer breakdown that includes all the categories listed in "detailedtable.xls".

I don't see how useful total PM emissions by region really is, especially considering much PM is secondary. I'd be inclined to eliminate 008b-3 and 008b-4. It might be more useful to show pie charts of source contributions by region.

Hidy: Make the condensable definition jump more clear by a call out on the graph.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: EPA trends reports often report data much earlier than 1990; why not include it here as well?

Civerolo: [no answer provided]

Fairley: I have a major complaint about how the source categories are named. It's unclear what the categories in charts 008b-1 and 008b-2 represent. The explanation in the "What the Data Show" section is incomplete. It says that "'on-road' vehicles include cars, trucks, buses and motorcycles." But what about them? I presume that both on- and non-road vehicle emissions include direct tailpipe emissions resulting from the burning of gasoline and diesel. If this is the case, then the "fuel combustion" category is quite confusing; another description is required. And I'm assuming that road dust is *not* included. What about tire and brake wear? "Fuel combustion" includes "emissions…from industrial…sources." yet there's another category called industrial. This is very confusing. For refineries, for example, what emissions are included in the "industrial and other processes" category? This section needs to be much better explained.

Which category does residential wood burning fit in? Is this considered as "residential heater"? What about the "waste disposal and recycling" category?

It seems very possible that geological dust is not included in the total. I note, in particular, that PM2.5 emissions are the substantial majority of PM10 emissions. For example, in 1990, PM2.5 was about 2,300 thousand tons versus about 3,200 thousand tons for PM10, or about 70% of the total. But if I'm not mistaken, PM2.5 constitutes only about 50% of ambient PM10 and much of that is secondary. Also, the vehicle contributions are almost identical. Are geological sources omitted, and if so, why? I note that there is a huge "miscellaneous" category in the file "detailedtable.xls" on http://www.epa.gov/airtrends/econ-emissions.html. Does this include geological? What else?

I would vote for categories that are more descriptive. How about separating out the largest emitters, e.g., power plants and refineries. Perhaps the current graph

The "What the Data Show" section states that total anthropogenic PM10 decreased 6% between 1990 and 2002, and PM2.5 by 4%. But the data are not comparable since, as I understand it, condensable PM was not included in 1990. So apples and oranges are being compared. If condensables are excluded, the reductions are something like 28% for PM10 and 23% for PM2.5 (using the data in the file: "detailedtable.xls" on http://www.epa.gov/airtrends/econ-emissions.html.

The "Indicator Limitations" section, states that "emissions data…are organized into … subsets of PM to minimize the extent to which methodological changes would bias this trend analysis" from the inclusion of condensable matter. But how? Where is condensable matter described, and where is it stated which subsets are being affected? In fact, the inclusion of condensable matter *does* bias the results.

Response to T1Q1. This could do with some rewriting. It starts talking about the "four main source sectors", but then never really discusses any but the Point source sector. How do these 4 sectors correspond to the 4 categories: fuel combustion, industrial and other processes, and on- and off-road vehicles? In particular, is the correspondence 1-to-1, or are some Point sources included in the "industrial and other processes" sector?

All Figures It is stated, and clear from the chart, that there is a discontinuity from 1998 to 1999. Yet the lines are continuous. The lines between 1998 and 1999 should be erased to so indicate. Perhaps it would be better to list only the trends starting in 1999.

Response to T2Q1 states that "The NEI is designed to explicitly answer the question posed in the ROE." But the question deals with trends, which means that an crucial aspect is comparability over time. This seems very much lacking.

Response to T2Q3. I would say the answer to this question is, basically, NO. There are no reference points, etc. that relate to total PM emissions. PM standards exists for ambient concentrations and these are related to health, but not for emissions as a whole.

T4Q1. If condensable matter is to be included, then there needs to be some estimate made for every year or else the trend comparison is fallacious.

T4Q4. Not mentioning the condensable matter issue is a major omission for this question.

Typos:

The footnotes to figures 008b-1 and 008b-2 say: "Starting in 1999, the emission estimation methodology was changed to include 'condensable' particulate matter." But part of the sentence is covered up in 008b-3 and 008b-4. I didn't see anywhere in the documentation where condensable matter was explained. Also "condensable" is spelled incorrectly.

Last sentence of paragraph 1 under "Indicator: Primary Particulate Matter Emissions (008b)" needs to be rewritten. It's not the *indicator* that describes how PM can harm human health & the environment, but the *text describing the indicator*.

1st sentence of paragraph 3 is missing a period.

There are a number of others. I hope this will be edited by a good proof reader.

Hidy: Looking at the graphs, it's hard to be convinced of any trend in either case, if one would add uncertainty bounds to the graphs.
QT1Q2—There is an incorrect statement about CEMS for PMx—only get opacity.
The NEI actually is done every 3 years+, so it's difficult to understand how EPA does the one year updates—this should be explained for the emissions results.
The answers to the questions are basic ally the same for all the emissions indicators. They should be written specifically for each one, so that one does not get the impression that the answers to these questions are a standard, statement coming out of some general manual.
The uncertainties in the PM data should be explained carefully.

7) Overall, this indicator:

Chinkin: X Should be included in ROE06 TD with the modifications identified above.

Civerolo: X Should be included in ROE06 TD with the modifications identified above.

Fairley: X Should be included in ROE06 TD with the modifications identified above.

Hidy: X Should be included in ROE06 TD with the modifications identified above.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **SO_2 Emissions**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3) Includes most sources using appropriate measurement techniques.

Civerolo: (4) Sulfur dioxide emissions are key to understanding acid deposition, visibility, and photochemical smog. This is a key indicator.

Fairley: (3)

Hidy: (3) SO2 emissions are important historic metric for air pollution, especially from large stationary sources. The use of the CEMs for these sources has greatly improved the data for such plants, particularly in the last decade. The SO2 emissions from small combustors and from area sources or transportation sources is much less reliable based on samples taken or on models used for estimation. The trends shown are probably a meaningful metric, which generally is adequate, appropriate and useful.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) Includes most sources using appropriate measurement techniques.

Civerolo: (4) Sulfur dioxide emissions are key to understanding acid deposition, visibility, and photochemical smog. This is a key indicator.

Fairley: (3) Virtually no one in the US lives in areas where SO2 exceeds national standards. Its main health impact is through ammonium sulfate, which constitutes a high percentage of PM2.5

in the eastern US. I would like to see this point made in the section headed "Indicator: Sulfur Dioxide Emissions (008d).

Hidy: (4) SO2 is an important, critical pollutant for health effects a PM precursor, acid rain and visibility impairment (through sulfate). The trends are perhaps best documented of all the criteria pollutants so this is an important measure.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (3) Emission inventories mostly based on direct measurements of large point sources (e.g. power plants).

Civerolo: (4) Sulfur dioxide emissions are key to understanding acid deposition, visibility, and photochemical smog. This is a key indicator.

Fairley: (1) Emissions estimates are mostly made from engineering calculations, not "actual measurements." So, it doesn't fit the indicator definition. However, I emissions estimates are still highly useful, that is, the fact these are generally not measurements doesn't invalidate them.

Hidy: (3) The data reported have no error estimates accompanying them. With the CEM results, at least, these errors should be readily accessible, and should be presented in the emissions data. The inventories should make clear that the non-CEM monitored facilities or transportation have a much larger error that should be resolved in the trends.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (4)
Fairley: (3)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (3)
Hidy: (3)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (2)
Hidy: (3)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (2)
Hidy: (3)

e) The data are comparable across time and space, and representative[2] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

[2] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Chinkin: (3)
Civerolo: (4)
Fairley: (3)
Hidy: (3)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (4)
Fairley: (2)
Hidy: (2)

Please explain:

Chinkin: [no answer provided]

Civerolo: SO_2 emissions are probably as straightforward to estimate as any other species, at least the large fraction that is emitted by electric utilities. As is stated in the report, they play crucial roles in a number of issues related to air pollution and deposition.

Fairley: Regarding d): The tracking of trends is limited by the lack of comparable data pre-1990 or between 1991 and 1995.

Hidy: SO2 trends are an important measure that historically has given the public confidence in the workability of emissions reductions.
The trends for large utility boilers are well documented particularly in the last decade based on the CEMS measurements. The data availability is less timely that would be hoped for. In general the results are comparable in time and space for the CEMS results, but less so for other sources. The underlying data for small industrial boilers and other stationary sources generally is reasonably well founded, relative to other pollutants, but no national level error analysis has been conducted on these results.
The change and trends are likely to be reliable, and are checked reasonably well by ambient data changes.

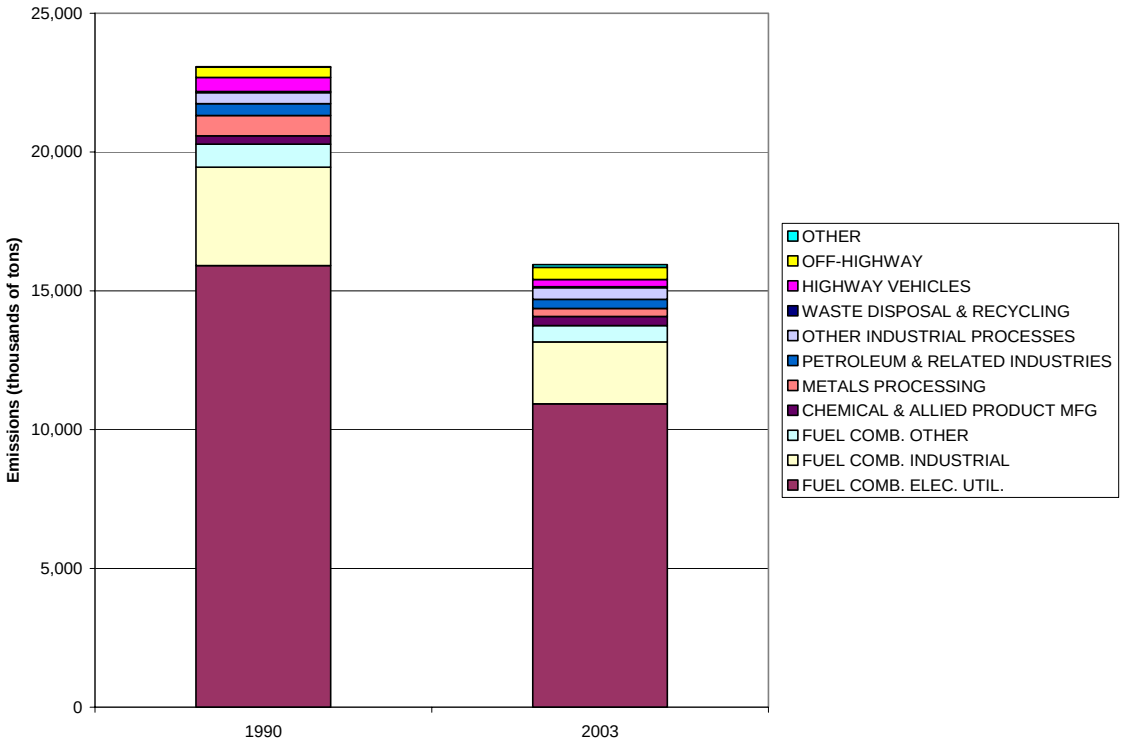
5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Recommend start graphs at 1996 or fix data gap between 1990 and 1996.

Recommend using different symbols and colors on line plots to better distinguish information.

Civerolo: It might be useful to include emissions estimates from the 1970s or 1980s to show how much they have declined even prior to Title IV

Fairley: As with PM, there are problems with the 1991-95 data gap. Also the categories, like "Fuel Combustion, Title IV", will not be comprehensible to the layman. This suggests a different graph, such as a stacked bar chart comparing 1990 and 2002 (or 03 or 04). Something like the following figure. (I would like a better name than "fuel combustion, other", since people may be confused into thinking this includes combustion from vehicles. (It doesn't, right?))



For the graphics by region, I think a chart with a map, like Figure 003-2, would be preferable, except perhaps again comparing just 1990 and 2003.

Hidy: It's unfortunate that there is a large gap in the graph 90-95. This should be filled in, even with data that may not be as reliable as the later data since there is a big jump downward during this period.
In Fig 008d-2—There is a need to show the change in western regions better; this graph shows these regions at low levels without any resolution in the data.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: EPA trends reports often report data much earlier than 1990; why not include it here as well?

Civerolo: [no answer provided]

Fairley: I did not see any explanation of the source categories listed in Figure 008d-1.

T1Q1 Does EPA estimate emissions from mobile sources? If so, it should be noted in this section.

T2Q2 Since the primary goal of ROE is to track trends, I would say that the emissions inventory is not doing a particularly good job in this regard.

Regarding the other questions, see the comments on PM Emissions.

Hidy: The narrative should be more clear where the annual updated data come from.
T1Q1—Like all of these answers—they appear to come from a "canned" program—HAPs have nothing to do with SO2, for example.

7) Overall, this indicator:

Chinkin: X Should be included in ROE06 TD with the modifications identified above.

Civerolo: X Should be included in ROE06 TD.

Fairley: X Should be included in ROE06 TD with the modifications identified above.

Hidy: X Should be included in ROE06 TD.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **NO_x Emissions**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3) Includes most sources using appropriate measurement techniques.

Civerolo: (3) As the text indicates, NOx emissions are very important to a number of environmental issues, including ozone and particulate formation, ecosystem acidification, visibility, and others. Solid estimates of these emissions are needed to tackle these issues.

Fairley: (3)

Hidy: (3) This is an important combustion criteria pollutant, the NOx emissions represent an adequate and useful metric for measuring national trends in both stationary source and transportation emissions.
NOx emissions are also important as a measure of changes in one of precursors of O3.
The underlying data for NOx is comparable for CEMs measured stationary sources, but more uncertain for transportation and non-CEMs sources. The uncertainty levels for these sources, particularly for real world transportation sources should be clear.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) NO_x contributes to fine PM, which has health effects on sensitive populations and NO_x contributes to ecological effects via acid deposition.

Civerolo: (4) While estimates of NOx emissions are somewhat uncertain (perhaps even more so than for SO_2), they are needed to run grid-based photochemical models, and they help track progress of emissions control programs.

Fairley: (3) NOx is an important precursor to both ozone and PM. This indicator shows the sources of NOx and the trends in each category. As with other emissions, I think the categorization could be improved. See my comments on SO2.

Hidy: (3) Important ROE metric for both O3 precursor and Criteria Pollutant' and is a factor in PM formation in the air, acid rain and visibility. Increasing evidence the NO2 may be an adverse health concern compared with PM or other gases

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (2) Emission inventories mostly based on direct measurements of large point sources (e.g. power plants). However, major contributors to NO_x emissions are based on estimation methods which vary by state and rely on estimated inputs not measured values.

Civerolo: (4) These estimates, however uncertain, represent our best understanding of NOx emissions on an annual basis. These emissions are directly and indirectly related to a substantial number of environmental issues, some of which are listed in the text.

Fairley: (1) See comments for SO2 emissions.

Hidy: (2) Large utility boilers are derived from CEMS measurements, but other sources are estimations based on sample measurements; transportation levels are generally modeled—questionable relation to real world fleets.
Questionable relation to health effects for short term exposures.
Link with ecological exposure from acidity or stress related to excessive nitrate deposition.
Recently problems have been identified with the reliability of the motor vehicle emissions component. The EPA emission trends have changed between 2000-2004. Analysis of the trends in NOx/CO ratio adds further evidence for high uncertainty in motor vehicle NOx trends.(See NARSTO 2005. *Improving Emission Inventories for Effective Air Quality Management across North America.* In press –ORISE -U.S. Government Printing Office(see NARSTO web site—for electronic version.www.cgenv.com/Narsto).

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (4)
Fairley: (3)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (3)
Hidy: (2)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (3)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (2)
Hidy: (2)

e) The data are comparable across time and space, and representative[3] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (4)
Hidy: (2)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (3)
Hidy: (2)

Please explain:

Chinkin: [no answer provided]

Civerolo: Please see my prior comments. My only reservation is that, unlike SO_2 where we pretty much know where most of the emissions are coming from, NOx has many natural and anthropogenic sources. If the methods for estimating NOx emissions from different source categories changes, it might complicate the interpretation when all source category emissions are summed.

Fairley: d) The time-span is limited, excluding pre-1990 and 1991-95 data.

Hidy: NOx emissions measure an important connection with ambient concentrations of a reactive gas. CEMs measurements are a solid base for large utility boilers (about 1/3 of emissions). However, transportation and small area combustion source data uncertain and even affects trends estimates, as reported in successive years by EPA. Need to be convinced that most recent estimates are reliable.

[3] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Recommend start graphs at 1996 or fix data gap between 1990 and 1996.
Recommend using different symbols and colors on line plots to better distinguish information.

Civerolo: Would it be possible to modify the figures to include older data, perhaps from the early to mid-1980s? Were there substantial reductions/changes prior to 1990?

Fairley: My comments here are the same as for SO2, namely, for 008a-1, the source categories should be better-described, and a bar chart comparing 1990 and 2002 (or 03 or 04) may be preferable.

If the regions are to be represented, a map would be preferable to the current figure.

Hidy: Can the CEMs component uncertainty be estimated to show on graph?
May want to update the data to the latest trends report.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: EPA trends reports often report data much earlier than 1990; why not include it here as well?

Civerolo: [no answer provided]

Fairley: In the introductory section, I would eliminate the mention of non-anthropogenic NOx from the 1st paragraph, since (I believe) it's a negligible source. I would make a separate bullet item for ammonium nitrate.

Typos

1st page, 2nd paragraph: "NOx play" should be "NOx plays".

Hidy: [no answer provided]

7) Overall, this indicator:

Chinkin: X Should be included in ROE06 TD with the modifications identified above.

Civerolo: X Should be included in ROE06 TD with the modifications identified above.

Fairley: X Should be included in ROE06 TD with the modifications identified above.

Hidy: X Should be included in ROE06 TD with the modifications identified above.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **VOC Emissions**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3)

Civerolo: (2) I'm not sure how useful that estimates of total non-methane VOC emissions themselves are. Changes in emissions of individual compounds can be used to track progress of control programs, changes in fuel mixes, etc. Some species are highly photochemically reactive, while others are not. Some are listed as highly toxic. I think that this indicator is more qualitative than quantitative.

Fairley: (3)

Hidy: (2) This metric may not be appropriate or useful within the ROE framework. VOC is an important class of pollutants that affect the oxidant production in the air, and thereby the production nitrate and sulfate, not to mention organic particles. Most of the attention today is on speciated VOC since they represent a broad class of species of widely ranging reactivity. Consideration should be given to choosing to or three specific VOCs that represent a range of reactivity.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) VOC contributes to ozone which has proven health effects on sensitive populations.

Civerolo: (3) Please see above comments. Emissions of VOCs are needed for photochemical modeling, but one needs information on species-specific (or classes of species) emissions to simulate ozone and particulate matter.

Fairley: (3) Important because it's an ozone precursor. Also, unlike NOx, there aren't reliable ambient VOC concentration measurements to use for trend analysis.

Hidy: (3) The measure of VOC is important from the standpoint of its relation to O3, and to production of other secondary species. The class also contains HAPs.

3) To what extent do you think the indicator meets the following indicator definition:

*An "indicator" is **a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition** over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (2) Emission inventories (especially for VOC fugitive sources such as leaks are very difficult to quantify accurately) are based on a variety of estimated inputs; not direct measurements.

Civerolo: (2) Again, this indicator may present a qualitative picture of how VOC emissions are changing over time. However, some species may be increasing, others decreasing, and others remaining fairly constant. It would help to know how a few important species are changing, in addition to the overall sum.

Fairley: (1) See comments for PM.

Hidy: (2) The VOC emission reported as a class are based largely on older sampling, which give a limited representation of a wide range of different sources that have changed in species over time and space. The exposure to health effects is largely indirect historically through O3 formation. However, now the exposure and health effects are tied to specific compound which are not reflected adequately in VOC.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (3)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (3)
Hidy: (2)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (3)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (2)
Hidy: (1)

e) The data are comparable across time and space, and representative[4] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

[4] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Chinkin: (2)
Civerolo: (2)
Fairley: (3)
Hidy: (1)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (3)
Hidy: (2)

Please explain:

Chinkin: Different agencies contribute to the NEI and use locally developed procedures and emissions estimation methods in some cases.

Civerolo: Similar to NOx emissions, there are a large number of source types for VOC emissions. However, since there are hundreds (thousands?) of VOC compounds, it must be difficult to keep track of all of these, except for perhaps the most abundant species. And, the most abundant VOC compounds are not necessarily the most important for photochemical smog formation

Fairley: d) See comments for NOx and SO2.

Hidy: The metric conceptually is an important element in managing O3 and other oxidant related compounds. However, VOC has really lost its meaning in terms of reactivity of species, and the HAPs contained in this category.
There is a variety of species present in gasoline and other sources like petrochemical plants that are changing or have changed that make trend estimation difficult.
There is evidence that the emissions of speciated VOC are very uncertain, and have misrepresented the control options for O3. (e.g. TEXAS AQ 2000— http://utexas.edu/research/ceer/texaqs/). This should be noted in the narrative as an important qualifier on estimates and emissions modeling that is otherwise not very reliable.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Recommend start graphs at 1996 or fix data gap between 1990 and 1996.
Recommend using different symbols and colors on line plots to better distinguish information.

Civerolo: I think it might be useful (if the data are available) to examine how one or a few particular species (e.g. acetylene?) – generally representative of a particular source type – have changed over the same time period.

Fairley: The same recommendations as for NOx and SO2 emissions.

Hidy: The graphics should done for trends in specific classes of compounds that represent VOC better than a lump sum.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: EPA trends reports often report data much earlier than 1990; why not include it here as well?

Civerolo: [no answer provided]

Fairley: [no answer provided]

Hidy: [no answer provided]

7) Overall, this indicator:

Chinkin: X Should be included in ROE06 TD with the modifications identified above.

Civerolo: X Should be included in ROE06 TD with the modifications identified above.

Fairley: X Should be included in ROE06 TD with the modifications identified above.

Hidy: X Should be included in ROE06 TD with the modifications identified above.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Lead Emissions**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3) *Pb emissions reductions are one of the success-stories of the nation.*

Civerolo: (2) While the health effects of lead are well documented, it appears from the text that current estimates of emissions are too uncertain to perform trend analysis. Although I indicate later that this indicator should be included with modifications, I would not object to this indicator being dropped from ROE06.

Fairley: (3) The key value of this indicator is to show why lead emissions have dropped so much since the 1970s. If the time interval is restricted to begin in 1990 or later, and there is no indication of the sources of lead emissions, then I don't consider this indicator worthwhile since there is also an ambient version.

Hidy: (3) Lead is a Criteria pollutant with a long record of measurement and monitoring in the environment. This metric is appropriate, useful and adequate. Lead is probably the best example that can trace ambient measurements to exposure to health effects (see for example, NARSTO 2000. *An Assessment of Tropospheric Ozone Pollution*. Report 1000040, EPRI, Palo Alto, CA pp. 5-4-5-5.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) Pb has proven health effects.

Civerolo: (2) It appears that the largest decreases in lead emissions occurred prior to 1990, and that the past emissions estimates are rather uncertain. It is not clear to me that air emissions of Pb, except in the vicinity of large known sources, are comparable to Pb levels in old paint, soil, water, etc. From an air emissions perspective, this may be if diminishing importance.

Fairley: (3) See Comments to 1).

Hidy: (4) This is an indicator that is important to the public, which generally expects to be appraised of Pb conditions from historical concerns.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (2) Emission inventories are based on a variety of estimated inputs; very few if any direct Pb measurements.

Civerolo: (3) I'm not sure if this merits a "2" or a "3," but I think the longer-term record of emissions, starting from the 1970s, would be more reflective of how Pb levels have changed in the environment.

Fairley: (1) See comments to SO2 emissions.

Hidy: (3) The indicator uses estimates of emissions based on sampling, and on the lead reductions in fuel and paint. Overall the determinations are reliable, except perhaps for sources existing today. The link with exposure to health is confounded by the removal of airborne lead, but not deposited lead or the flaking of lead paint which strongly affects some people today.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (3)
Hidy: (4)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (3)
Hidy: (3)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (2)
Hidy: (3)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (2)
Hidy: (2/3)

e) The data are comparable across time and space, and representative[5] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

[5] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (3)
Hidy: (3)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (2)
Hidy: (3)

Please explain:

Chinkin: Different agencies contribute to the NEI and use locally developed procedures and emissions estimation methods in some cases.

Civerolo: Please refer to my earlier comments. I believe that current emissions estimates need to be taken in context with a longer time period.

Fairley: c), e), and f) Because the data are a collection of estimates from many agencies using varying methodologies, there is some question about the comparability of the data across time and from area to area. Also, only an expert would be able to assess the "assumptions, analytic methods, and statistical procedures employed."

d) Because the time interval is so short, the indicator fails to tell the main story, the plunge in ambient lead concentrations due to the removal of lead from gasoline.

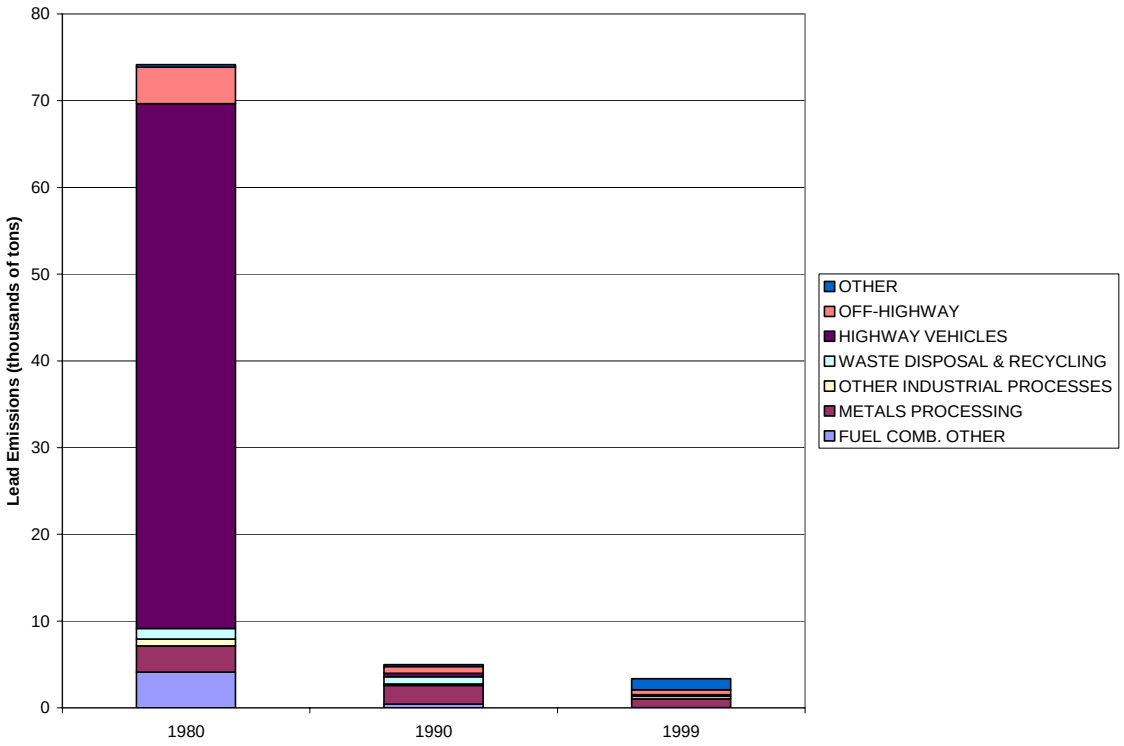
Hidy: The Pb emissions estimate is important from a public perception. The trends should be linked with health effects—blood lead and exposure. The trends shown should go back to the 1970s—this makes a better historical story.
The data based on fuels and paint production are reliable nationally, but the current estimates from smelters and lead m battery operations are problematic.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Recommend start graph at 1970.
Recommend using same style as for other emissions trends.

Civerolo: Consider showing earlier trends, ca. the 1970s, to display the dramatic reductions in lead, primarily from gasoline. Also, are estimates for 2002 available? The text states that EPA does not report trends in Pb anymore, but perhaps the estimates from 2002 could be displayed in the figure.

Fairley: I would like to see all emissions indicators using a longer baseline – back to 1980 if not 1970. This would be my vote unless it were clear that doing so would create a misleading picture.



The advantage of including data back to 1980 is to make it clear where the reductions took place (i.e., the phase-out of lead in gasoline).

Hidy: Should take data back to the 1970s and include an ambient measure as well as blood lead in population to give a complete picture.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: Lead emissions appear essentially flat from 1991-1998, with two decreases in 1990 and 1999. What are the reasons for this? Are the emissions too uncertain to point to specific reasons? Are there additional reductions/changes to be expected in the coming years?

Fairley: There was such a dramatic decline in lead emissions from 1970 to the present that it is not just a shame, but also misleading, not to show progress. The errors made in using dated emissions estimates are minor, I am guessing, relative to the decline.

The "what the data show" section says "emissions reductions over the longer term are much greater…the overwhelming majority of this reduction attributed to the phase-out of leaded motor vehicle fuels…" YES! *But the data presented don't show it*. That's why it's important to go back earlier than 1990.

Hidy: The narrative and the answers to the technical questions grossly over-simplifies the toxics –HAPs issues. Some serious effort to improve this section is needed if this ROE is to be kept in the list.

7) Overall, this indicator:

Chinkin: _X_ Should be included in ROE06 TD with the modifications identified above.

Civerolo: _X_ Should be included in ROE06 TD with the modifications identified above.

Fairley: _X_ Should be included in ROE06 TD with the modifications identified above.

Hidy: _X_ Should be included in ROE06 TD.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Air Toxics Emissions**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (2) Air toxics emission estimation methods are still in their infancy compared to criteria pollutants. Lumping all air toxics together could obscure trends in important individual toxic element.

Civerolo: (2) Similar to total VOC emissions, comparing changes in total air toxic emissions provides only a qualitative assessment. Furthermore, at this point in time it does not appear that there are ample estimates to examine trends. Rather, as this report is finalized, there will be baseline (1990-93), 1999, and 2002 estimates only. It would be helpful to also look at one or a few species of interest – benzene, formaldehyde, etc. Because these compounds have well documented public health consequences, it warrants inclusion in this ROE; however, this indicator will certainly become more important in future reports.

Fairley: (3) This indicator would be valuable if modified to include toxicity. Otherwise, I think it is worthless.

Hidy: (1) The metric for air toxics, as shown in Fig.110-1 is not adequate, appropriate of useful to describe the national characteristics of trends in 1888 different HAPs. At the very least, a selection of organics and metals complementing the data on Hg and benzene should be used for this indicator.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (2) Some air toxics have proven health effects.

Civerolo: (2) Different air toxics are emitted from a variety of sources, they have different effects on humans and animals, and their emissions estimates span orders of magnitude. By examining air toxics as a whole, it is not possible to track changes in any given toxic or group of toxics that pertain to a given source category.

Fairley: (3) Trends in toxics emissions are clearly important. But this indicator fails to provide meaningful trend figures. The indicator merely adds the tonnages of toxics emitted. But toxicities differ by many orders of magnitude. A ton of arsenic has a different toxicity from a ton of toluene. Lumping all toxics together by tonnage is essentially meaningless. Trend estimates will be dominated by toxics with the greatest emissions, not the greatest toxicities. Moreover, toxics come from a wide variety of sources, so trends will undoubtedly vary from toxic to toxic.

Hidy: (3) Air toxics are a class of compounds that are important to the public, but have not received sufficient attention in describing their emissions or trends as HAPs. The data being collected under CERCLA (TRI) would be more appropriate as a metric for selected species than lumping the total tonnage together as done in this proposed ROE.
Some way to designate potency and exposure is needed to bring perspective to this class of pollutants.

3) To what extent do you think the indicator meets the following <u>indicator definition</u>:

   *An "indicator" is **a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition** over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (2) Emission inventories (especially for toxics sources such as leaks are very difficult to quantify accurately) are based on a variety of estimated inputs; not direct measurements.

Civerolo: (2) Again, with 188 compounds/groups in the total air toxics emissions originating from a wide variety of source types, the total emissions number may not be particularly informative. Also, from the limitations section, it appears that there is substantially more uncertainty in compiling estimates of air toxics than for, say, SO_2.

Fairley: (1) As I've explained above, trends in tonnages don't draw attention to meaningful environmental trends.

Hidy: (1) The estimates of HAPs emission are generally pretty unreliable. The sampling done to date or the emission factors rely on spotty data, some of which is quite old. The measurements trace through exposure to health effects in complex ways, and result in different diseases. The proposed approach to handling this group of pollutants severely oversimplified their trends and their relative toxicity.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (1)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (2)
Hidy: (1)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (3)
Hidy: (1)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (3)
Hidy: (1)

e) The data are comparable across time and space, and representative[6] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (1)
Hidy: (1)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (3)
Hidy: (1)

Please explain:

Chinkin: Different agencies contribute to the NEI and use locally developed procedures and emissions estimation methods in some cases.

Civerolo: Please refer to my above comments.

[6] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Fairley: e) The target population is anyone susceptible to detrimental health effects from toxics, namely everyone. To have a meaningful toxics indicator, it would have to represent trends correlated with actual toxicities. This indicator fails this criterion.

Hidy: Developing in ROE to describe in some way the conditions with regard to HAPs is an important metric of public interest. However, the generic approach taken in this write-up is not successful in this goal.
The data available on which to base emissions estimates is very limited, and much of it is not timely. The data do not give adequate coverage in space and time, and they are of questionable reliability.
The transparency of the lumped toxics category is low.

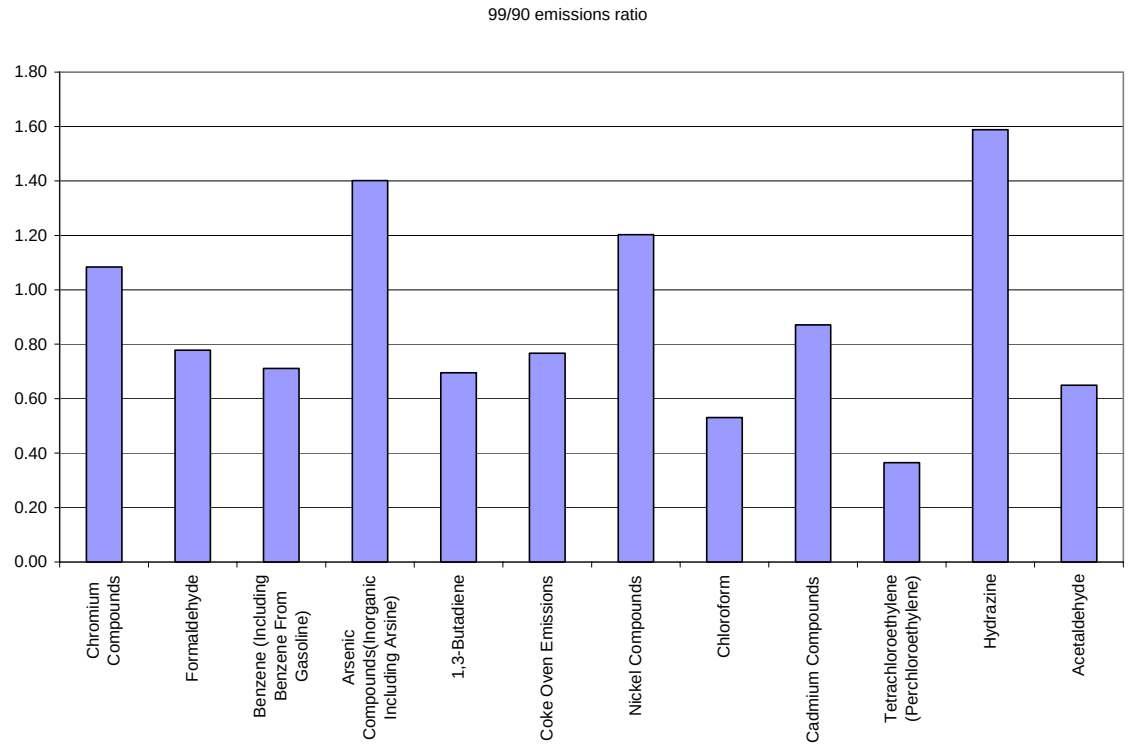
5) Do you have any suggestions for more effective graphic presentation of the data?
If yes, please describe.

Chinkin: Recommend present as area line graph like other plots, but showing risk-weighted most important groups of toxics.

Civerolo: I think it would help to also illustrate how emissions of a few individual toxics have changed over this period in time. Benzene seems a likely candidate, since ambient concentrations of benzene is later proposed as an indicator for this report.

Fairley: As an alternative graph, consider choosing 6 to 12 of what appear to be the most serious toxics, and doing simple bar charts comparing 1990 and 2003, either comparing total emissions, or showing % decrease. It would be nice to have a short narrative for each toxic, saying what the major sources are, what the toxicity potential is and, if there has been a sizeable decrease in emissions, what measures caused the improvement.

The table below shows compounds that may pose the greatest carcenogenic risk. A number of these would be useful to include. It would probably be worthwhile to include others that do not have carcenogenic risk numbers attached but have other serious health effects (e.g., neurological, developmental, hormonal). I suspect that some emissions estimates are more reliable than others. Compounds should be excluded if their trend estimates are not reliable.



Hidy: It would be better to pick a few example metal and/or organic pollutants and trace their changes and discuss the limited reliability of the data here.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: I would add that this indicator will become more useful and important in the coming years as emissions estimates are improved.

Fairley: Just adding up toxics data to determine trends is like using the total amount of minerals mined to estimate mining trends – making gravel as valuable as gold. This indicator makes no sense without some weighting by toxicity. As suggested above, an alternative is to pick the 6-12 or so toxics that appear to pose the greatest health risks, and show their trends individually.

The following table shows the compounds that may pose the greatest carcenogenic risk.

Caveat: The following table is intended to be illustrative, not definitive. The risk factor doesn't match the compound in every case.

Compound*	Risk Factor**	1999 Total Emissions (t/y)	RxE 1999	1990 Total Emissions (tpy)	RxE 1990	99/90 emissions ratio
Chromium Compounds	1.20E-02	927	11.13	856	10.27	1.08
Formaldehyde	1.30E-05	295912	3.85	380264	4.94	0.78
Benzene (Including Benzene From Gasoline)	7.80E-06	350777	2.74	493424	3.85	0.71
Arsenic Compounds(Inorganic Including Arsine)	4.30E-03	406	1.75	290	1.25	1.4
1,3-Butadiene	3.00E-05	57909	1.74	83292	2.50	0.7
Coke Oven Emissions	6.20E-04	1353	0.84	1764	1.09	0.77
Nickel Compounds	2.40E-04	1529	0.37	1271	0.31	1.2
Chloroform	2.30E-05	15139	0.35	28508	0.66	0.53
Cadmium Compounds	1.80E-03	174	0.31	200	0.36	0.87
Tetrachloroethylene (Perchloroethylene)	5.90E-06	46792	0.28	128102	0.76	0.37
Hydrazine	4.90E-03	56	0.27	35	0.17	1.59
Acetaldehyde	2.20E-06	92782	0.20	142829	0.31	0.65
1,3-Dichloropropene	4.00E-06	28573	0.11	19928	0.08	1.43

* Compounds chosen with the greatest risk times emissions (RxE
** In some cases, risks may not correspond to compound. For example, the 1.2E-02 risk is for hexavalent chromium, not all chromium compounds.

This table illustrates 1) that there is a huge range in risks – a range of more than a factor of 1,000, and emissions. The population health risk is roughly proportional to the product, not simply the tonnage, and 2) that there is a large range in trends, from perchloroethylene, where the 1999 emissions are only 37% of the 1990 emissions, to hydrazine, where the 1999 emissions are 159% of the 1990 emissions.

Another serious problem is lack of inclusion of important toxics such as diesel exhaust and wood smoke. Although components of these sources are included, their overall toxicity is one or two orders of magnitude greater than the sum of toxicities of the identified components.

Diesel emissions trends themselves, provided these were relatively robust estimates, would be a good addition.

T2Q1 states "This indicator esimates emissions from all sources of a primary air pollutant." Actually, it is a hodgepodge of 188 or so pollutants.

Hidy: The narrative and the answers to the technical questions grossly oversimplifies the toxics –HAPs issues. Some serious effort to improve this section is needed if this ROE is to be kept in the list

7) Overall, this indicator:

Chinkin: _X_ Should *not* be included in ROE06 TD.

Civerolo: _X_ Should be included in ROE06 TD with the modifications identified above.

Fairley: _X_ Should be included in ROE06 TD with the modifications identified above.

Hidy: _X_ Should *not* be included in ROE06 TD.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **CO Emissions**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3*)* CO emissions reductions are one of the success-stories of the nation.

Civerolo: (4) Carbon monoxide is still an important air quality issue, especially in large urban areas with a large number of on- and non-road vehicles.

Fairley: (3) Again, this indicator would be much more valuable if extended back to 1980

Hidy: (3) As a Criteria pollutant CO is an important indicator for air pollution. The ROE metric, in principle, is a useful one, especially in conjunction with ambient measurements.
The metric is appropriate and useful, but may not be adequate. There are questions about the EPA reported trends that present major uncertainties in the emissions when compared with ambient data (e.g. NARSTO 2005. *Improving Emission Inventories for Effective Air Quality Management across North America.* in press, Ch. 7. These need to be resolved before using the emissions data.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) CO has proven health effects.

Civerolo: (4) These emissions are a good indicator of motor vehicle and other anthropogenic emissions. Emissions appear to be decreasing monotonically since 1996, primarily from the mobile source sector.

Fairley: (3) Although most areas of the US now meet national CO standards, the picture was very different in 1980. CO continues to be a health concern. Seeing the *long-term* trends will help citizens understand that consider

Hidy: (3) CO is an important, traditional marker for pollution, especially motor vehicle pollution. Readers will expect to see this pollutant in the EPA report, both for emissions and ambient concentrations.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (2) Emission inventories are based on a variety of estimated inputs; very few if any direct CO measurements.

Civerolo: (3) It is clear that emissions have decreased over the past decade or so. However, it would help to update the emissions from 1991-1995 so they could be included in the figure.

Fairley: (2) See comments on SO2 emissions.

Hidy: (2) The numerical values are derived from sampling of sources, and in particular modeling of motor vehicle emissions. The estimates will be ambiguous given real world fleet conditions and driving, with unspecified uncertainty. The exposure to CO and consequent health effects are relatively well documented.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (4)
Fairley: (3)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (4)
Fairley: (3)
Hidy: (3)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (2)
Hidy: (3)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (4)
Fairley: (2)
Hidy: (2)

e) The data are comparable across time and space, and representative[7] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

[7] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Chinkin: (2)
Civerolo: (3)
Fairley: (3)
Hidy: (2)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (2)
Hidy: (2)

Please explain:

Chinkin: Different agencies contribute to the NEI and use locally developed procedures and emissions estimation methods in some cases.

Civerolo: As I stated earlier, I suggested that the estimates from 1991-1995 be included in the figure. The text states that emissions decreased by 33% percent between 1990 and 2002. The figure suggests that since 1996, the changes have been smaller. It might help to list a few reasons for the relatively drop between 1990 and 1996, and more discussion on why the 1991-1995 data were not updated.

Fairley: See comments to Lead Emissions.

Hidy: The metric represents an important trend, especially tied with motor vehicles. The data derive from modeling results that are believed to be state of the art, but do not necessarily simulate actual fleet conditions. As noted above there are problems with the reported trends, depending on the year of the reports (See NARSTO report). These discrepancies need to be checked ands the latest trend reports need to be verified. The narrative should note discrepancies and uncertainties to assist the reader in appraising the reliability of the trends.
The data on trends have not been reproducible from year to year in NEI reporting.
The modeling done to obtain CO estimates is not particularly transparent or traceable.

5) Do you have any suggestions for more effective graphic presentation of the data?
If yes, please describe.

Chinkin: Recommend start graphs at 1996 or fix data gap between 1990 and 1996.
Recommend using different symbols and colors on line plots to better distinguish information.

Civerolo: If time permits, please update the figure to include years 1991-1995.

Fairley: For Figure 330-1, see comments on SO2 emissions. Note that the trends have been roughly linear, but this fact is obscured by the way the graph is drawn.

I don't see the regional emissions trends as being very useful. Total tonnages by region doesn't tell people very much. Per capita emissions would be more interesting. Although it might be somewhat misleading, in that the downtrends would likely be greater than the ambient downtrends (assuming that population density has increased). On the other hand, it would emphasize the fact that cars, trucks and other CO sources are generally getting cleaner.

Hidy: The data should be reported further back in time, and compared with growth in motor vehicles, or fuel combustion over the same time period.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: EPA trends reports often report data much earlier than 1990; why not include it here as well?

Civerolo: I would add that despite increasing vehicle miles, CO emissions from motor vehicles are still declining as control technology improves and newer vehicles enter the fleet.

Fairley: As with all the other emissions indicators, a longer baseline would be valuable.

Hidy: The answers to the technical questions appear to be a "standard" response found for essentially all of the emissions data.

7) Overall, this indicator:

Chinkin: _X_ Should be included in ROE06 TD with the modifications identified above.

Civerolo: __X__ Should be included in ROE06 TD.

Fairley: _X_ Should be included in ROE06 TD with the modifications identified above.

Hidy: _X_ Should be included in ROE06 TD with the modifications identified above.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Mercury Emissions**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (2) Mercury emission estimation methods are still quite uncertain compared to criteria pollutants.

Civerolo: (3) Similar to air toxics emissions, there are not sufficient estimates to report trends in mercury emissions. However, the addition of "new" mercury into the atmosphere does have serious public health implications. Also, the estimates from 1990 and 1999 illustrate well the decrease in waste incineration.

Fairley: (3)

Hidy: (3) The measure is appropriate and useful for characterizing a perceived important worldwide-U.S. pollutant. The metrics may not be adequate to give the perspective of a global pollutant on which the U.S. emissions are superimposed.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) Mercury has proven health effects.

Civerolo: (3) While this indicator has demonstrated success in reducing Hg from waste incineration, there are many sources that are not included. These likely include small point sources, which can have local impacts, and any emissions from mobile sources. Are sources such as disposal of fluorescent bulbs or old switches accounted for in these estimates? Mercury is also a global problem, and it would help to show how US emissions compare to those in other countries.

Fairley: (4) I think this is a worthwhile addition to the ROE (not present in the 2003 version). Unlike the other pollutants, whose primary health effect is via inhalation, mercury's primary pathway is (apparently) from eating fish. Thus, total tonnage is roughly proportional to (the US contribution to) mercury concentrations in fish & hence to dosage.

Hidy: (4) The public has considerable interest in Hg at the moment, based on media and EPA representation of the threat in the food chain.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment*.

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (2) Emission inventories are based on a variety of estimated inputs; not direct measurements

Civerolo: (3) These are likely the best available estimates of emissions of "new" anthropogenic mercury into the environment. However, Hg cycles throughout the atmosphere as it converts to different forms, deposits, and can be re-emitted elsewhere.

Fairley: (1) See comments to SO2 emissions.

Hidy: (3) The indicator is based on calculations of emissions using a very limited number of samples. Hg emissions are complicated by the fact that emissions are speciated, which is not represented in the inventory. The tonnage of Hg released in the U.S. is small (50 tpy), and it is unclear quantitatively what the food chain exposure is and what the consequent health effects are through the consumption of certain kinds of fish.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (3)
Hidy: (4)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (3)
Hidy: (2)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (2)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (3)
Hidy: (2)

e) The data are comparable across time and space, and representative[8] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (3)
Hidy: (1)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (3)
Hidy: (2)

Please explain:

Chinkin: Different agencies contribute to the NEI and use locally developed procedures and emissions estimation methods in some cases.

Civerolo: There are not enough estimates to elucidate trends in Hg emissions. And, as I stated earlier, while these are likely good estimates of known sources of mercury (especially point sources), the emissions from area and mobile sources may be highly uncertain/unknown.

Fairley: c) and e) As discussed elsewhere, emissions estimates are collected from many different agencies with a variety of methodologies and levels of quality control.

Hidy: The currently is great public interest in Hg so that a measure of emissions from different sources is useful.
There is difficulty in determining the underlying reliability of the emissions data, and its reproducibility in time and space.
There is another category shown in the estimate which is relatively large, but unidentified. More discussion in the narrative. The calculation is not really transparent or reproducible

[8] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Recommend present as area line graph like other plots, but not if there are only two data points in trends.

Civerolo: [no answer provided]

Fairley: I think the graph, 316-1, is a good one & could serve as a template for other emissions graphs.

Hidy: [no answer provided]

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: I would add that there are natural emissions, such as volcanoes, and that Hg that is deposited to the land or oceans can be re-emitted back to the atmosphere. Also, this indicator will become more important in the coming years as better estimates become available.

Fairley: 1st paragraph, second sentence: "However, many processes…have increased the amounts of mercury released to the air." This is pretty vague. As a non-expert, I'd like to know the order of magnitude relative to natural processes. Do anthropogenic emissions add 1%, 100% or 10,000%? My guess is it's closer to 10,000%. If so, I'd like to see the sentence modified either with a relatively precise number, if available, or else a qualifier such as "have *greatly* increased".

In the "What the Data Show" section, I am curious why gold mining emissions went from virtually zero in 1990 to 10 tons/year (or so) in 1999.

Hidy: The introduction in the narrative needs some work. The first paragraph is kind of trivial—The para. Might discuss more about the global nature of Hg as a pollutant, and emphasize strongly that the health consequences are in the food chain—unlike essentially all other air pollutants that affect the respiratory system and beyond. Also it should be noted how little the U.S. emissions are relative to essentially all other air pollutants regulated.
In this way some perspective can be place on this toxic metal and its elimination from emissions.

7) Overall, this indicator:

Chinkin: _X_ Should *not* be included in ROE06 TD.

Civerolo: _X_ Should be included in ROE06 TD with the modifications identified above.

Fairley: _X_ Should be included in ROE06 TD.

Hidy: _X_ Should be included in ROE06 TD with the modifications identified above.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Ambient PM**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3)

Civerolo: (3) PM10 concentrations have been monitored on a wide basis since the 1980s, while PM2.5 concentrations have been widely reported since about 1999-2000. Ambient PM levels have been linked to numerous public health metrics. However, while the air quality standards are tied to PM10 and PM2.5 mass, understanding the sources of PM and the subsequent effects on visibility or acidic deposition requires information on species composition, which are not presented here.

Fairley: (4) The use of seasonally weighted averages is an appropriate metric because these are used in the standard, and because annual averages have been shown to be correlated with many serious health impacts.

Hidy: (3) PM10 and or PM2.5 generally meet the requirements. The are appropriate and useful measures of air quality, and are Criteria pollutants. There is some question of the adequacy of the metric to be compared with emission. Both PM10 and PM2.5 have a large fraction that is secondary in nature, which links their trend and change to precursor gases.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (4) PM has proven health effects on sensitive populations

Civerolo: (3) There are enough PM10 concentration data to estimate trends, but the PM2.5 record is much shorter. Trends over five years are highly subject to meteorological and climatological variability. Still, observed ambient concentrations may be indicative of changes in emissions of precursors.

Fairley: (4) PM appears to be the ambient air pollutant with the most serious health effects. Thus, it is critical that some metric of concentrations and trends be included.

Hidy: (3) The indicators reflect trends in Criteria pollutants of major current interest for their influence on health effects, visibility, and acid deposition.

3) To what extent do you think the indicator meets the following indicator definition:

*An "indicator" is **a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition** over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (4)

Civerolo: (3) The trends in PM10 and PM2.5 are important from the mass-based air quality standard perspective, and are indicative of general air quality, but information on PM composition may be equally as important from a human health and welfare perspective. The IMPROVE network has species composition information at rural sites, while the EPA Speciation Trends Network sites are now providing this information at urban sites.

Fairley: (4) The indicator shows trends in average ambient PM10 concentrations. These levels are roughly proportional to health impact, which appear as approximately linear functions of PM concentration.

Hidy: (3) Based on ambient measurements with a large spatial coverage, both urban and rural. Temporal measurements are limited by sampling frequency The method is based on gravimetric measurement, which has certain ambiguities associated with semi-volatile components. Characterizing PMx depends on knowledge of the composition. While composition is being measured, its coverage a much smaller no. of sites than mass concentration. The link with health effects is complicated by exposure ambiguities associated with indoor and outdoor conditions. In general there is little direct data on exposure of ecosystems to PMx.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

e) The data are comparable across time and space, and representative[9] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (3)
Hidy: (2)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

Please explain:

Chinkin: Indicator needs to better account for effects of varying meteorological conditions on apparent trends.
Indicator needs to address sampling artifacts (e.g., nitrate evaporation and organic carbon evaporation and condensation on filter-based measurements).

Civerolo: Again, my only reservations are that (1) the trends in the short PM2.5 data records may be uncertain, and (2) PM species composition information is needed.

Fairley: e) The indicator shows an average across long-running sampling sites. There is no necessary correlation between the site locations and population. However, EPA siting guidelines require monitoring in large urban areas, so that the trends and concentrations presented in Figures 003-1 and 003-3 will roughly parallel total population exposure.

[9] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Hidy: The measures are important from a public interest standpoint.
The current data base has a limited accuracy, partly because of no reference standards, and partly because of known problems with semi-volatiles.
The temporal coverage is limited, but costs limit daily coverage.
Spatial comparison and temporal comparisons are good, with a national QC/QA program.
The data base for PM2.5 is limited since the network goes back only to 1999. The change in ambient conditions with emission is unclear because of the large fraction of PM2.5 which depends on gaseous precursors (e.g. SO2, NOx and certain VOCs.)
For PMx. There is a substantial contribution from fugitive dust and wildfires, which. complicates interpretation.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Figures need to show number of sites/yr above NAAQS.
Is central tendency shown the average or median (since the plot shows percentiles)?
Trends in figures should show a regression line and percent reduction over time using the regression line not the change in the observed end points.

Civerolo: [no answer provided]

Fairley: Figure 003-1 shows the level of the NAAQS, suggesting that virtually everyone is breathing healthy air. There appears to be general agreement that this standard is not health protective. I'd be inclined to omit it from the figure.

Figures 003-2 and 003-4 don't show a great deal, in my opinion. There are different trends in different regions, but why? and what does it really mean? Do low PM counties in Region 9 have steeper trends than low PM counties in Region 8? Or do we see bigger decreases in PM for counties that start off with higher PM no matter where the county is located? I would much prefer figures shown down to the county level. I think a figure like Exhibit 1-8 from ROE2003 is much preferable (though the color scheme could be improved). Showing such figures for the earliest year and the most recent year would provide localized information about trends.

Hidy: The data should be reported further back in time, and compared with growth in motor vehicles, or fuel combustion over the same time period.

The IMPROVE data trends for rural sites also should be shown with appropriate regional maps.
Better or alternate graphs would include change in sulfate and total carbon for PM2.5.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: The text lists a limitation that there is far more urban monitoring of PM than rural monitoring. This is true, but there is information available from the rural IMPROVE network, which has reported PM2.5 and PM10 mass since the late 1980s at Class I areas across the nation.

Fairley: 1st paragraph, last sentence: "PM2.5 also has a seasonal pattern because some of the secondary particles involved in its formation vary by seasonal emission and/or transport." This sentence is incomplete in several ways. First, there are different seasonal patterns in different parts of the country. In the West, in urban areas, maximum PM often occurs in the winter. In Eastern urban areas, the PM is as high or higher in the summer. In rural areas, PM can be higher at other times, like the fall due to wind-blown dust. Second, seasonal patterns occur for a variety of reasons. In the West, wintertime inversions trap PM close to the ground and periods of stagnation allow PM buildup. In addition, people burn a lot more wood in the winter & this is a major PM2.5 source in many areas. Yes, secondary PM can vary by season, but at least in the West the key secondary pollutant is ammonium nitrate. It peaks in the wintertime not because of "seasonal emission and/or transport," but because of cooler temperatures.

In the "What the Data Show" section, I'd like to see the phrase "with most of the decrease occurring between 1988 and 1996" clarified. How much? It would be nice to have emissions bar charts comparing 1988, 1996 and 2002 (or the latest year). This would make a good complement to the ambient concentration data.

T2Q2 The response doesn't scan and is unclear: "The network is focused on sensitive populations…, but samples them proportion to their occurrence in the general populations of the areas monitored." In the first place, should it be "samples them in proportion"? Secondly, it isn't the populations that are being sampled, but PM. The reality is that the ambient monitoring network is not designed to represent populations, let alone sensitive populations. It would be more honest to say this.

T4Q1 The response doesn't address what I believe is the intent of the question. The indicator shows PM10 concentrations and trends from a set of monitoring sites, but the ultimate questions of interest are PM10 effects on people and the environment. As is made clear elsewhere, the monitoring sites are mainly located in urban areas. Thus, rural and suburban population exposures are likely under-represented. Similarly, the trends may not be representative of environmental effects such as visibility in national parks.

Hidy: [no answer provided]

7) Overall, this indicator:

Chinkin: _X_ Should be included in ROE06 TD with the modifications identified above.

Civerolo: _X_ Should be included in ROE06 TD with the modifications identified above.

Fairley: _X_ Should be included in ROE06 TD.

Hidy: _X_ Should be included in ROE06 TD with the modifications identified above.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Ambient Ozone Concentrations**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (4) Ozone is relatively well-understood by the public because of considerable outreach.

Civerolo: (4) Ground-level ozone is still a persistent problem, and as the 8-hour standard is phased-in and more areas are in non-attainment, it will continue to be a major air quality/public health issue. In addition, ozone levels vary widely from year to year as a result of emissions and meteorological variability, making trend assessment particularly difficult.

Fairley: (4) Using the 8-hour design value precisely tracks progress toward meeting the 8-hour ozone standard. I would have preferred use of the running 4th highest 1-hour O3 over the previous 3 years, but the 2nd max is not a bad surrogate.

Hidy: (4) The measure is important as a indicator of the level of photochemical smog present in cities. O3 is one of the two Criteria pollutants current in anon-attainment in some locations. The measure is appropriate, useful and is adequate.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (4) Ozone has proven health effects on sensitive populations.

Civerolo: (4) I believe that this is a critical indicator, and even though it appears that peak levels have been reduced in recent years, will continue to be something we need to monitor closely.

Fairley: (4) The impact of ambient ozone on health is still considerable. As Figure 004-3 shows, about half of the monitoring sites continue to violate the 8-hour standard, indicating that a large portion of the US population is live in areas with unhealthy smog levels

Hidy: (4) A key contemporary pollutant that needs to be an indicator—measure of smog and oxidative potential of the atmosphere. Needs to be in the report to compare with any discussion of stratospheric O3.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (4) Well-established dense network of monitors nationally.

Civerolo: (3) It is very important to estimate how maximum 1-hour and 8-hour concentrations have changed in recent years. For each of the indicators in the air section, it appears that the EPA has reported the percent change between an emission/concentration in a starting year to that in an ending year. If an indicator has changed more or less monotonically over time, this is probably OK. I don't believe that this is the case for ozone, which can differ substantially from year to year. Reporting a percent change from, say, 1980 to 2003/4 ignores what is occurring in the intermediate years.

Fairley: (4) The indicator shows trends in the 8-hour design value, and a close estimate of the 1-hour design value. Thus, they are directly tied to progress toward meeting national ozone standards.

Hidy: (3)

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (4)
Fairley: (4)
Hidy: (4)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (4)
Fairley: (4)
Hidy: (3)

e) The data are comparable across time and space, and representative[10] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

[10] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Chinkin: (4)
Civerolo: (3)
Fairley: (2)
Hidy: (3)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

Please explain:

Chinkin: Indicator needs to better account for effects of varying meteorological conditions on apparent trends.

Civerolo: There's no question that the highest ozone concentrations are not as high as they were in the 1970s and 1980s. I think that this is evident in Figure 004-1, which shows that the 1-hour maximum values are still decreasing. The 8-hour maxima are another story; from Figure 004-3, it appears that the largest gains were made prior to 1990, and that concentrations have leveled off for the most part (and that it may be difficult to expect further reductions). I think that Figures 004-2 and 004-4 illustrate the limitation of considering a percent difference in time, as well. If one looks at the results from Region 10, for example, when you compare the 1980 and 2004 values you conclude that 1-hour O_3 is unchanged and that 8-hour ozone is increasing. However, if one were to consider 1981 or 1982 as the starting year, it appears that you might conclude that maximum O_3 levels are decreasing. In Region 7, the percent drop from 1980 to 2004 is 22% and 15% for 1-hour and 8-hour O_3, respectively; if one looked at 1982 as the starting year, I don't think you would draw the same conclusion. My point is that even region-wide average values can change dramatically from year to year, and it is necessary to consider what is happening over the entire record.

Fairley: e) The indicator shows an average across long-running sampling sites. But they do only a modest job at connecting with the main point of interest, namely exposure of human populations to unhealthy ozone concentrations.

Hidy: The different concentration metrics are important and generally reflect both national and regional conditions. The data are based on well founded methods, with the possible deception that there may be evidence of bias in the method. The data are virtually all taken using a uv photometer so that they are comparable spatially and temporally. The data are transparent and reproducible. O3 concentrations are largely driven by meteorological conditions in the summer seasons. Thus the trends may be somewhat misleading as to what actually is occurring wrt to precursors and O3 formation. There may be value in showing as much rural data as possible since there is a regional O3 issue in the East.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Figures need to show number of sites/yr above NAAQS. Is central tendency shown the average or median (since the plot shows percentiles)? Trends in figures should show a regression line and percent reduction over time using the regression line not the change in the observed end points.

Civerolo: [no answer provided]

Fairley: i) I find figures 003-2 and 003-4 relatively unuseful. Consider Region 9. It contains areas that have always met the national ozone standards and Los Angeles and the San Joaquin Valley, which have close to the most extreme ozone in the US. The regions are so large that the comparisons are virtually meaningless.

As an alternative, it would be quite useful to provide maps with ozone concentrations by county. The input data would be design value estimates by county, where I would use 3 years (1980-82 and 2002-04). For the 8-hour standard I would use the average of 4th highest values, which is the official EPA design value. For the 1-hour standard I would use the 4th highest value in 3 years (the average of 2nd maxima would be okay). I would have two maps for each standard – one for 1980-02 and one for 2002-04. In the maps, the design values would be color-coded from (something like purple for the highest ozone to something like green or blue for ozone that meets national standards). Perhaps the color coding could correspond to the EPA designations – extreme, serious, severe, moderate marginal…

These maps would show readers a tremendous amount. First, it would show what areas were actually used in the trend analysis. Second, it would show those living in those areas about the progress in their area and how serious the problem still was. It would also show where progress has been strong (coastal areas in the West, for example), to where it has been weaker (inland areas).

ii) The strength of Figures 004-1 and 004-3 is to show that there has been real progress in reducing unhealthy ozone levels overall. But what they don't show, is how this relates to human health. An alternative (or addition) to these figures would be ones that showed the number of counties that violated the standards (and by how much), comparing the earliest year(s) with the most recent. I suspect there would be large variations from year to year. This effect would be dampened by considering 3-year or 5-year averages.

Hidy: Add trends in rural data if the data are available at more than a few sites.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: One of the stated limitations is that most of the O_3 monitors are located in or near urban areas. There are some 80-90 generally rural Clean Air Status and Trends Network (CASTNet) monitors across the country that could be analyzed in a similar fashion.

Fairley: Figures 004-1 and 004-3 present decreases for 1980-2003 and 1990-2003 in such a way as to be misleading. With a steady downtrend (or even a slightly increasing downtrend), the decrease in a longer period will be greater than the shorter. The real question is the *rate* of decrease. The "What the data show" section says that "…the downward trend appears to be slowing." It is, but the way the data are presented makes it look like the slowdown is much greater than it is. In 004-1, the decrease is 24% from 1980-2003. If we consider the annual rate of decrease, r say, then

$(1 – r)^{23} = 1 - .24$

Solving for r yields .0119, or 1.19% per year. The rate of decrease from 1990-2003 satisfies

$(1 – r)^{13} = 1 - .11$

yielding r = .0089, or 0.89% per year, still lower than the overall 1980-2003 rate, but closer.

In the second paragraph of the "What the data show" section, it says "Although … 474 counties (or parts of counties) in the United States experienced violations of the … standard…" I definitely think this is valuable information but, actually, the indicators *do not* show this. This provides evidence for one of my main criticisms of the approach that's being taken for the 2006 ROE.

One thing to point out in the "What the data show" section is the sizeable year-to-year variation in ozone values, e.g., 1987-89, and make a comment about extreme ozone concentrations being highly dependent on extreme weather conditions. It could also be mentioned that this leads to large year-to-year variations in the % of days with AQI > 100.

T2Q2 See comment in my Ambient PM comments.

T4Q1 I disagree. There was no real effort to "generalize or portray the data beyond the time or spatial locations where measurements were made." That is, there was no projection before 1980, after 2004 or to counties where ozone monitoring was insufficient to provide long-term trend information.

T4Q3 I think there should be some effort to provide confidence intervals for trend estimates. This is relatively simple given the underlying data. An interval based on the Wilcoxon test or the t-interval could be used, for example: for the 1980-2004 8-hour comparison, let Xi = 4^{th} highest 8-hour ozone value for site i for 1980, Yi = 4^{th} highest 8-hour ozone value for site i for 2004, and let Zi = Yi/Xi – 1. To compute the t-interval, simply find the standard error of the Zi, s say, then the interval would be $0.24 \pm 2*s/\sqrt{299}$. The hypothesis that the rate of progress has slowed could also be tested, e.g., looking at the differences Yi/Wi – Wi/Xi, where Wi = 4^{th} highest 8-hour value for site i in 1992.

Hidy: [no answer provided]

7) Overall, this indicator:

Chinkin: _X_ Should be included in ROE06 TD with the modifications identified above.

Civerolo: _X_ Should be included in ROE06 TD with the modifications identified above.

Fairley: _X_ Should be included in ROE06 TD.

Hidy: _X_ Should be included in ROE06 TD.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Ambient Lead Concentrations**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (4) Pb reductions are one of the success-stories of the nation.

Civerolo: (3) Reducing lead from the atmosphere has truly been a success story from an environmental management perspective. There is no question, however, that lead is still a public health issue.

Fairley: (4)

Hidy: (4) Pb is a good success story for an indicator if coupled with the emission trends and the blood lead picture. It would be desirable also to have a rural picture and a spatial concentration story for the U.S. by blending the IMPROVE and urban data together to get a trends picture over the past 10-20 years.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) Pb has proven health effects.

Civerolo: (3) While lead is still present in the environment in many forms, is it possible that the atmospheric pathway is not as important from a human exposure perspective (except in areas affected by known large sources)? I don't think that lead exposure is no longer an issue, I just wonder if more attention should be paid to other sources.

Fairley: (4) I agree that "lead remains an important environmental issue." It also shows that tremendous progress can and has been made in reducing ambient concentrations of harmful air pollutants.

Hidy: (4) Pb is a Criteria pollutant and is an indicator of the success of a major effort to reduce this pollutant from the air.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (4)

Civerolo: (3) Please refer to my earlier comments. Also, the data only pertain to 20 urban areas. I would actually rate this a 2.5. It would help to see Pb emissions starting from the 1970s or 1980s to see the longer-term trends/changes.

Fairley: (3) The indicator clearly meets the first part of the definition. The weakness of this indicator is that it is based on only 20 monitoring sites. I still think that the picture that this indicator presents is basically valid: There would have been few areas in 1980 where there were elevated lead levels *not* caused by the lead in motor vehicle exhaust. Thus, the trends in the 20 monitors are likely reflective of trends elsewhere. Also note that the trends among the 20 sites are quite consistent, with 90% of the sites in 2003 having concentrations lower than (at least) 90% of the sites in 1980.

Hidy: (4) The measurement is direct from filter PM data, is well QA'd and has a direct link with blood lead. The health component may be confounded to an extent by dust from Pb based paint indoors, but nevertheless is believed to be a sound link with atmosphere to health marker.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (4)
Hidy: (4)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (4)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (4)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (3)
Hidy: (4)

e) The data are comparable across time and space, and representative[11] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (2)
Hidy: (4)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (4)

Please explain:

Chinkin: Most Pb reductions occurred more than 20 years ago, old news now.

Civerolo: Again, there is no question that air concentrations of Pb have decreased, but it might help to discuss other sources of lead, possibly in another section of the ROE.

Fairley: d) and e) The indicator shows an average across long-running sampling sites. There is no necessary correlation between the site locations and population. The fact there are only 20 monitors is somewhat worrisome. Although the average reduction from 1990 to 2003 is 67%, a 95 percent sign test confidence interval is 58% to 79%, (95 percent interval based on the t-test is 52% to 77%) and that assumes that the set of monitors represents a random sample, which they don't.

Hidy: Pb is a good example ROE through argument as an indicator, its measurement, and chain of accountability. The trends of airborne lead are well established and linked closely with reductions in emissions. The link with a health marker is well established as well, with the note on the possible confounding from Pb based paint indoors, or nearby buildings.

[11] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

The picture of lead is best presented by showing on the same page (?) all three measures.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Figures need to show number of sites/yr above NAAQS.
Is central tendency shown the average or median (since the plot shows percentiles)?

Civerolo: From the mid-1990s onward, it is difficult to tell whether or not Pb concentrations are still decreasing. You might consider adding another panel, or an inset in this panel, which focuses on the last 10 years on a logarithmic scale.

Fairley: [no answer provided]

Hidy: It would be desirable to show the national picture (spatial) for urban and rural with combining urban data with IMPROVE data

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: I think it might be helpful to provide a sense of how important the atmospheric pathway for human exposure is, compared to ingesting contaminated water, food, non-food, etc.

Fairley: It would be nice if there were more than 20 monitoring sites included in the trend analysis. In the Bay Area, I believe we stopped measuring lead concentrations in 1997. This violates the conditions described in T1Q3. I agree that care needs to be taken with missing values, but biases can be introduced by limiting the sample too much. If I'm reading the data right, there are 20 sites from only 8 states. Could it be that the sites that have remained operational are those whose lead levels are unusually high? If so, this may bias the trend estimates. I wonder how many sites would meet the completeness criteria if the time scale were limited to 1980 to, say, 1995?

In the "what the data show" section it says "In 2003, ambient air concentrations of lead exceeded EPA's health-based air quality standards in only two counties nationwide." In the first place, the data presented *do not* show this. Secondly, it should be noted how many counties are currently monitoring for lead. I realize that monitoring may have been discontinued in many areas because lead levels were so low. If this is the case, then it should be acknowledged somewhere.

T2Q1 and T2Q2 There should be some acknowledgement of the limited number of monitoring sites used in the analysis. To say that "The national monitoring network for the six criteria air pollutants is extensive," seems disingenuous if only a few of them are monitoring lead.

T4Q1 I disagree. There was no real effort to "generalize or portray the data beyond the time or spatial locations where measurements were made." That is, there was no projection before 1980, after 2004 or to counties where lead monitoring was insufficient to provide long-term trend information.

T4Q3 There should be some attempt to identify the statistical variation in the data. A simple approach is to use a sign test on the individual-site % reductions. As mentioned above, this yields 58% to 79% for the range of reduction from 1990 to 2003, and 93% to 99% reduction for the reduction from 1980 to 2003.

Hidy: [no answer provided]

7) Overall, this indicator:

Chinkin: _X_ Should be included in ROE06 TD with the modifications identified above.

Civerolo: _X_ Should be included in ROE06 TD with the modifications identified above.

Fairley: _X_ Should be included in ROE06 TD.

Hidy: _X_ Should be included in ROE06 TD.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Ambient Concentration of a Selected Air Toxic: Benzene**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (2) Indicator is based on limited number of sites.

Civerolo: (3) Air toxics are increasing in importance, and benzene is among the more widely monitored compound. It would be useful to add benzene emissions to the air toxics emissions chapter (010).

Fairley: (4)

Hidy: (2) Benzene is not an appropriate or necessarily a useful measure of HAPs as an indicator. The metric does not appear to be adequate in choice for a representation of HAPs index.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (2) Indicator is not representative of all air toxics.

Civerolo: (3) One of the main sources of benzene is motor vehicles, and tracking benzene in the air can help evaluate how effective control programs and different gasoline formulations are.

Fairley: (3) Annual average ambient benzene concentrations are closely associated with people's long-term exposure – which is believed to reflect the corresonding cancer risk. The indicator is limited in that it measures just one of hundreds of toxic compounds, and only at a limited number of sites.

Hidy: (2) Benzene is of modest importance as a carcinogen. It has largely lost its impact as a HAPS from major reductions in its use in gasoline and as a solvent in industry. The marker does not represent a broad based metric for HAPs. There are better choices for an ROE , including both organics and metals.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (4)

Civerolo: (3) While it is important to report trends in benzene concentrations in this ROE, some readers might be interested in one or two additional species that are of particular interest to their urban areas. More species would give the reader a better sense of how air toxic compounds overall are changing in time. Also, the data only pertain to 35 urban areas.

Fairley: (3) The main caveat is that the data are limited to 35 sites. Like lead, the trends are very likely representative of trends elsewhere, however, because the dominant source is (I believe) related to the formation of gasoline.

Hidy: (3) The ROE is based on ambient measurements, presumably mostly PAMS data recently. There is a reasonable link with exposure and health consequences.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (2)
Hidy: (2)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (3)
Hidy: (2)

e) The data are comparable across time and space, and representative[12] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

[12] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Chinkin: (2)
Civerolo: (3)
Fairley: (3)
Hidy: (2)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

Please explain:

Chinkin: Indicator is based on a limited number of sites.

Civerolo: Again, there is relatively good information available on benzene concentrations. I just wonder if there aren't other toxic compounds for which there is comparable (but likely less) information. This is only on piece of the air toxics "puzzle."

Fairley: a) Benzene is one of many toxics. This indicator alone may not parallel overall trends in toxics exposure.

e) The indicator shows an average across long-running sampling sites. There is no necessary correlation between the site locations and population. As shown in Figure 007, the spatial coverage misses most of the US.

Hidy: The measure is only of modest importance as an ROE.
The ROE is not representative of HAPS in general; if used should accompany a larger set of metrics for HAPS. The data base is not representative of urban conditions nationwide, and depends on the complex use of VOC monitoring, which has had problems with QC/QA.
The data are not necessarily representative of time and space variation since they depend on relatively few monitors. The data appear to be primary taken from the Gulf Coast and a few other locations.
The indicator is not necessarily a transparent measure of HAPS.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Recommend using same graphical style for all indicators.

Civerolo: The site locations are somewhat hard to identify. It might help to use a color like red for clarity.

Fairley: [no answer provided]

Hidy: Graphics should include a broader range of organics and metals to reflect trends in HAPS

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: Plot is labeled "annual" average, but I think it might be summer season data.

Civerolo: If time permits, it might be useful to illustrate how one or tow other toxic compounds have changed over recent years; perhaps something like perchloroethylene, which is emitted from entirely different sources.

Fairley: Should something be said about benzene specifically – that it's a carcenogen? other health known effects? What about estimated population risk?

The relative paucity of ambient toxics information helps make the case that there should be more use made of the toxics emissions data. I wonder what fraction of people's overall toxic risk is due to benzene. To what extent are benzene trends reflective of trends in other pollutants.

The "What the data show" section discusses why benzene levels dropped, which is good, but these data don't show why. What would show why would be a plot like Figure 008d-1 showing emissions trends broken down by source category.

Hidy: It's unclear why benzene was selected as a metric for HAPs. This needs to be explained in the narrative more carefully if this ROE is used.

7) Overall, this indicator:

Chinkin: _X Should *not* be included in ROE06 TD.

Civerolo: __X__ Should be included in ROE06 TD with the modifications identified above.

Fairley: __X__ Should be included in ROE06 TD.

Hidy: __x_ Should *not* be included in ROE06 TD.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Ambient Concentrations of Carbon Monoxide**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (4) CO reductions are one of the success-stories of the nation.

Civerolo: (4) The health effects of carbon monoxide are well known, and it is still an important issue, especially in urban areas.

Fairley: (4)

Hidy: (4) CO is a traditional metric for air quality as a Criteria pollutant. The indicator is appropriate, and adequate for a national outlook.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) CO has proven health effects.

Civerolo: (4) Carbon monoxide concentrations have decreased dramatically since the 1970s and 1980s, and continue to do so today. However, areas with high combustion or motor vehicle sources still experience elevated CO concentrations, and ambient levels still need to be monitored closely.

Fairley: (4) CO is one of the original criteria pollutants and has been a serious health threat. The large reductions in CO concentrations is a success story that Americans should know about.

Hidy: (3) CO is an important measure of air pollution in cities. It is associated mainly with the transportation sector, and gives a measure of improvement in the vehicle fleet emissions across the U.S. Its importance from a health effects standpoint is likely to be less than other pollutants, though it definitely is a negative at high enough concentrations.

3) To what extent do you think the indicator meets the following indicator definition:

*An "indicator" is **a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition** over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (4)

Civerolo: (4) Trends in CO have been monotonically decreasing since the 1980s, and this trend is generally consistent across the different regions of the country.

Fairley: (4) The indicator certainly meets the first part of the definition. The fact that the monitoring network is widespread makes it likely that the trends shown are reflective of corresponding trends in CO exposure in a large fraction of the US population.

Hidy: (4) The indicator is based on a long standing collection of urban measurements in most larger cities. The link between the ambient concentrations and exposure to health effects is clear at high enough concentrations. CO does not affect ecosystems significantly, but plays a role in O3 production on a regional scale that can be important under some circumstances.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (4)
Fairley: (4)
Hidy: (4)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (4)
Fairley: (4)
Hidy: (3)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (4)
Fairley: (4)
Hidy: (3)

e) The data are comparable across time and space, and representative[13] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

[13] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Chinkin: (4)
Civerolo: (3)
Fairley: (3)
Hidy: (3)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (4)
Fairley: (4)
Hidy: (3)

Please explain:

Chinkin: [no answer provided]

Civerolo: The data presented here indicate that in urban areas across the country, CO concentrations have decreased substantially. There are data from some more rural sites that indicate that background CO is also decreasing. [e.g. Hallock-Waters et al., "Carbon monoxide in the U.S. Mid-Atlantic troposphere: evidence for a decreasing trend, Geophys. Res. Lett., vol. 26(18), pp. 2816-2864, 1999.]

Fairley: e) The indicator shows an average across long-running sampling sites. There is no necessary correlation between the site locations and population. Also, there is no direct relationship between the indicator and trends in the number of people exposed to unhealthy CO concentrations.

Hidy: The indicator is important as a Criteria pollutant.
The measurements on which the trends or changes in space and time are based are considered well founded, but the coverage of sites for measurements is limited, and may be insufficient to characterize spatial gradients in cities relative to traffic patterns.
The data are transparent and reproducible. The recorded trends have had an important role in verifying emissions trends for Co and for the relationship between CO and NOx from motor vehicles.

5) Do you have any suggestions for more effective graphic presentation of the data?
If yes, please describe.

Chinkin: Figures need to show number of sites/yr above NAAQS.
Is central tendency shown the average or median (since the plot shows percentiles)?
Trends in figures should show a regression line and percent reduction over time using the regression line not the change in the observed end points.

Civerolo: [no answer provided]

Fairley: It would be quite useful to provide maps with CO concentrations by county. The input data would be design value estimates by county, where I would use 3 years (1980-82 and 2002-04). I would like to see two maps – one for 1980-02 and one for 2002-04. In the maps, the design values would be color-coded from (something like purple for the highest CO to something like green or blue for CO that meets national standards).

Hidy: The ambient data should be compared carefully with emissions in the graphics.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: Indicator needs to better account for effects of varying meteorological conditions on apparent trends.

Civerolo: [no answer provided]

Fairley: I think it's appropriate to omit trends in the 1-hour CO standard since they are quite similar to the 8-hour trends.

I note that there is no mention in the "what the data show" section of any estimate of how many people are exposed to unhealthy CO levels and how that's changed over time. To me this is a major omission.

T2Q2 See comment in my Ambient PM comments.

T4Q1 I disagree. There was no real effort to "generalize or portray the data beyond the time or spatial locations where measurements were made." That is, there was no projection before 1980, after 2004 or to counties where ozone monitoring was insufficient to provide long-term trend information.

T4Q3 I think there should be some effort to provide confidence intervals for trend estimates. This is relatively simple given the underlying data. See Ambient Ozone discussion.

Hidy: [no answer provided]

7) Overall, this indicator:

Chinkin: X Should be included in ROE06 TD with the modifications identified above.

Civerolo: __X__ Should be included in ROE06 TD

Fairley: __X___ Should be included in ROE06 TD.

Hidy: __x_ Should be included in ROE06 TD.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Days That MSAs Have AQI Values > 100**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (4) Many cities rely on AQI for AQ public outreach programs such as Spare-the-Air Days.

Civerolo: (2) The AQI is currently a popular way to communicate air pollution on a given day to the general public, and is being incorporated into near-real-time forecasting programs. It is generally dictated by the ozone concentrations on the given day, and as such, is subject to the same year to year variability in ozone concentrations (please refer to my comments on indicator 004). Thus trends in AQI metrics are difficult to assess

Fairley: (2) The AQI itself is a useful measure and could make a valuable contribution to ROE2006. But the way the indicator for the AQI has been developed leaves much to be desired. PM2.5 has been measured only since 1999 in most areas. I note that there is a large jump in the AQI between 1998 and 1999. A look at the data on the EPA website confirms that this is because of the inclusion of PM2.5 starting in 1999. This important feature must be made clear, and it isn't.

Another issue is how the metropolitan areas were selected. Why not use all monitoring sites that have sufficient data? Why weight all MSAs equally instead of by population?

Also, the time interval chosen, 1990-2003, is short considering the large variability of the indicator.

Hidy: (2) The AQI is a useful index for day-to-day changes in air quality based on a combination of pollutant concentrations. However, it is largely meteorologically driven, and has questionable value in providing an ROE for measuring sustained changes in air quality.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3)

Civerolo: (2) In terms of trends, I am not sure that the number of high AQI values per year is providing more information than trends in ambient ozone concentrations, since the AQI is basically driven by ozone. Also, the AQI only applies to larger metropolitan areas.

Fairley: (4) This comment is conditional upon fixing the problems discussed above.

Hidy: (3) The metric is important on a day-to day basis for the public who is concerned for variation in exposure. It's unclear how to use the index for long term measures of change in air quality.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (3) Its not measured but scaled from measured values of various pollutants.

Civerolo: (2) Again, you may want to refer to my comments to the ozone concentrations chapter (004). The number of days with AQI > 100 varies from year to year. To state that there was a decrease in this number between 1990 and 2004 ignores this variability in the intermediate years. The figures indicate, to me at least, that the number of days with AQI > 100 has remained unchanged or possibly increased. This indicator might be useful, but the "trend" results presented in this chapter are somewhat misleading.

Fairley: (3) Again, this comment is conditional on the fixing the problems discussed above.

Hidy: (2) The measurement is based on a weighted combination of concentrations of different pollutants. The index has nebulous relationships with exposure and health or ecological effects.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (3)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (4)
Hidy: (2)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (3)
Hidy: (1)

e) The data are comparable across time and space, and representative[14] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (3)
Hidy: (1)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

Please explain:

Chinkin: Its based on data from a well-established dense network of monitors nationally.

Civerolo: Please refer to my earlier comments.

Fairley: d) There are no PM2.5 data before 1999. Thus, before/after comparisons are not possible.

e) The indicator shows an average across long-running sampling sites. There is no necessary correlation between the site locations and population.

f) This comment is conditional on fixing the problems described above.

Hidy: The index is a useful daily predictor or recorder of air quality, but as a mix of pollutants it is difficult to interpret in terms of long term improvements. The index is not transparent in its calculations based on the narrative given.

[14] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

The data are not amenable to simple interpretation of spatial or temporal changes or for trend analysis in terms of cause and effect.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Show a figure like other indicators: number of cities or sites per year against AQI scale by percentiles.
Trends in figures should show a regression line and percent change over time using the regression line.

Civerolo: [no answer provided]

Fairley: First, using the scale of "days" makes little sense. There are only 365 (or 366) days in a year. How can there be over 500 days with AQI over 100??? I assume that this scale is something like MSA-days, the summation of the numbers of days in the 93 MSAs where the AQI exceeds 100. This still has little relevance. The other scale – "percent of total days" – is not unreasonable, though it weights every MSA equally. It might be somewhat more meaningful to weight the numbers by MSA population. Then, it would represent a rough measure of exposure.

Because PM2.5 data are available only since 1999, it would make more sense to break down the AQI by pollutant. This would show several things – the trends for each pollutant, and their relative importance. The one disadvantage would be failure to show the total fraction of days with AQI > 100. There should be a note that makes clear that PM2.5 data were not available before 1999.

The AQI tables on the EPA website include "ozone only" AQI trends. Because of the fact that the inclusion of PM2.5 in 1999 obscures the trend, it would be preferable to consider showing this instead. Also, there is a table showing AQI going back to 1980. Below is a figure based on these data. The trend is much clearer, and the plot is still based on a large number of metropolitan areas.

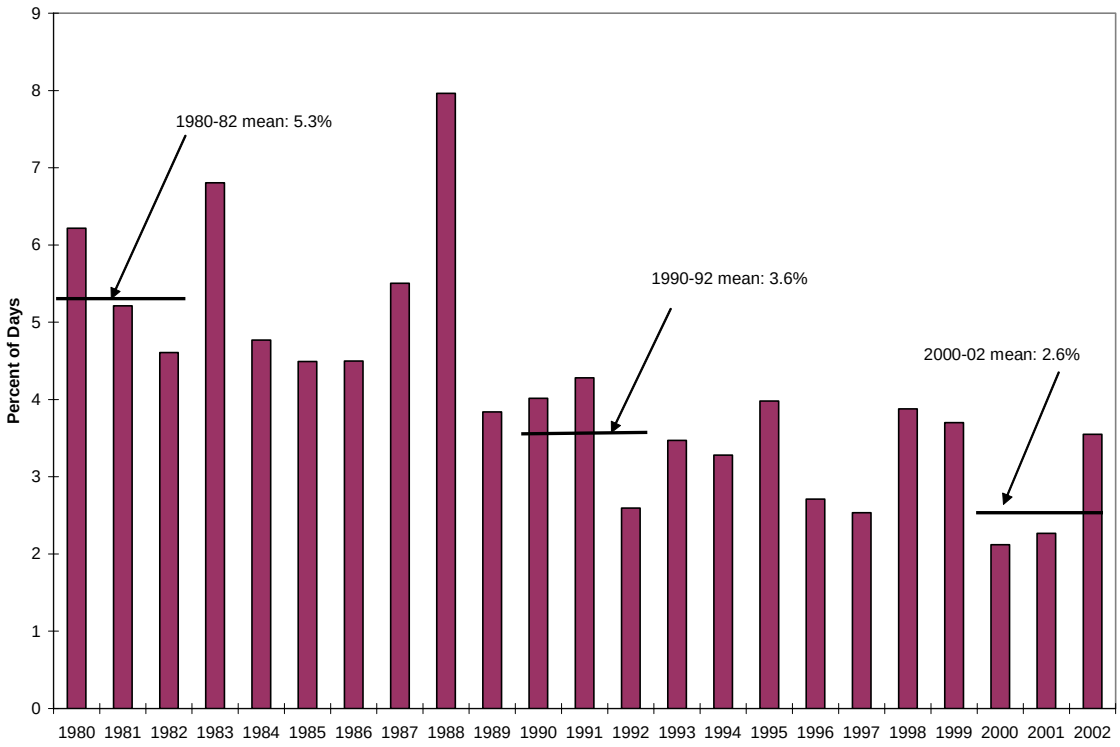


Figure. AQI Trends for ozone, 1980-2002. Annual percent of MSA-days with ozone exceeding 100 AQI in 85 Metropolitan areas with long-term records.

This figure is still limited in that it only includes MSAs with large populations and that it weights all MSAs equally. An alternative method would be to compute this metric by county and get a population-weighted average of percent of days with AQI > 100.

Figure 001-2: As with many of the other indicators, I don't find a summary by region particularly useful. These regions include areas that range from squeaky clean to very dirty, and the trends in these areas are likely very different. Using an average across the whole region obscures these facts. It would be much more useful to see trends by MSA. As suggested before, there could be maps for 1990 (or 1990-92) and 2004 (or 2002-04) showing AQI percentages by color.

Hidy: This graphic not convincing that there is any trend at all in the index. This is logical since the measure is largely meteorologically driven.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: Indicator needs to better account for effects of varying meteorological conditions on apparent trends.

Civerolo: I wonder if it would be useful to examine trends in the maximum AQI values each year, or possibly considering a higher threshold. The figures don't indicate to me that the number of high AQI days is decreasing. Since the AQI is driven by ozone primarily, it might be possible to include some of this discussion (in reduced form, perhaps without a figure) in chapter 004.

Fairley:
The introductory paragraphs describing the AQI leave a lot to be desired. It should be made clear in the 1st paragraph that the AQI is a measure of the severity of the pollutant concentrations, with levels greater than 100 representing levels considered unhealthy. There should be mention that PM2.5 has only been available since 1999.

In the "what the data show" section, the discussion doesn't explain why it's important that there are 1,649 days or 1,207 days with AQI > 100 in 93 MSAs. I certainly don't know. Also, it totally fails to mention PM2.5. Wasn't this included? It says that "since 1993, ozone has been responsible for between 96 and 98% of" the days when the AQI was greater than 100. But not if PM2.5 is included! In fact, in 1999, the percentage drops to 79% and in 2000 it's 65% !! I was able to ascertain this by comparing the "ozone only" table with the table including all criteria pollutants (from the tables at: http://www.epa.gov/airtrends/factbook.html).

Note also that the statement that the values in 2003 are 27% lower than 1990 changes totally if 2002 were used instead. In fact, the values for 2002 are *greater* than for 1990 (because of the inclusion of PM2.5), so if this interval had been used, there would have been an increase in the number of days with AQI>100. My point is not that this is the case. There is a general downtrend in the # of AQI days > 100, but that this is a quite volitile indicator, so that a longer time interval, such as 1980-2003, should be used.

These facts greatly obscure the real trend. Using the ozone only table days with AQI > 100 drops from 1523 to 792, a drop of 48%, not the 27%. Because of the large volatility of the AQI percentages, I think several years should be averaged, as I've done above. There, the percentage of days with AQI > 100 dropped from 3.6% to 2.6%, a drop of 28%.

In the "indicator limitations" section, PM2.5 is not mentioned. This is a serious omission. Including PM2.5 increased the percentage of days with AQI > 100 by about one-third.

In the Data Sources section, the reference is listed as Table A-16, National Air Quality and Emissions Trends Report, 2003. In fact, the table (that I found on the web at http://www.epa.gov/air/airtrends/aqtrnd03/fr_table.html) does not show AQI > 100. Table 17 does, but only starting in 1993 not 1990, and ending in 2002, not 2003. By the way, Table 17 contains an error. It suggests that PM2.5 was included starting in 2000. Actually, it started in 1999 at least in some areas, like Fresno, Bakersfield, San Francisco, and Los Angeles.

T3Q1, T3Q2 As mentioned above, the data used in the figures are not available at the referenced location. The data go from 1993 through 2002, not 1990 through 2003. They do seem to be available at: http://www.epa.gov/airtrends/factbook.html.

T4Q1 The response only partially answers the question being asked, which is focused on the *generalization* of the results to other areas and times. The issue of the sampling frequency is dealt with, but I didn't see any rationale for the choice of large metropolitan areas.

Hidy: [no answer provided]

7) Overall, this indicator:

Chinkin: __X Should be included in ROE06 TD with the modifications identified above.

Civerolo: __X_ Should *not* be included in ROE06 TD.

Fairley: __X_ Should be included in ROE06 TD with the modifications identified above.

Hidy: _X_ Should *not* be included in ROE06 TD

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Ambient Concentrations of Manganese Metal Compounds**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (1) Indicator is of limited usefulness because of limited availability nationally (even if it is very important regionally).

Civerolo: (2) Manganese appears to have serious human health implications, and is of special interest to Region 5. I'm not sure how important this indicator is on a national basis, though, especially since there are few ambient measurements available for trend analysis.

Fairley: (2) The choice of this indicator seems somewhat arbitrary in that it's effects appear generally localized, and I am unclear the extent to which this poses a more serious health risk than other toxic compounds. If toxic metals are of concern, what about hexavalent chromium, for example, which is monitored at many sites in California, and presumably elsewhere? What about PAHs, dioxins…?

Hidy: (2) Mn as an indicator is not of great interest as an appropriate measure of national air quality or even regional air quality. It is not very useful as a measure of metal HAPs and the coverage in terms of exposure to the populations is limited and not adequate.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (1)

Civerolo: (2) I would think that chromium, cadmium, or several other metals listed as urban hazardous air pollutants would be at least as important as manganese in terms of human health. It's also not clear to me that there are enough data over space and time to make too much sense of the estimated trends

Fairley: (2)

Hidy: (2) Mn does not appear to be a not an important or useful metric for national air quality—only applies significantly apparently to the Great Lakes region.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (3)

Civerolo: (None) Please see above comments.

Fairley: (4)

Hidy: (2) Mn is measured in terms total suspended particle concentrations, a poor metric for exposure to airborne particles. TSP is not relevant to current exposure criteria, and is not comparable to speciation data now being collected. The relation to exposure and health are not well stated in this case.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (2)
Hidy: (2)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (4)
Hidy: (2)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (2)
Hidy: (1)

e) The data are comparable across time and space, and representative[15] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

[15] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Chinkin: (2)
Civerolo: (2)
Fairley: (2)
Hidy: (1)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

Please explain:

Chinkin: [no answer provided]

Civerolo: The analysis presented here applies to one EPA region; it might help to expand the analysis to include as much Mn concenration data as possible, even those from other regions. Most of the trends presented here are not significant. Are the average concentrations of 0.006-0.34 μg m^{-3} above some reference or threshold level for human exposure?

Fairley: d) The indicator is available from a limited number of sites, and many of these have not been operating for the period the trends are shown for, 1994-2003.

e) It's unclear to what extent the monitored levels reflect exposure.

Hidy: The metric is not very important as a health risk. The daa are confounded in the Great Lakes by trans-boundary transport associated with the use Mn (MMT) as an anti-knock agent for gasoline in Canada. The graphic would be helped if large Mn sources were located on the map. The data are of unknown quality and the graphic gives an unclear message about air quality and its improvement.
TSP confuses large diameter dust with fine particles, which has been reduced greatly using PM10 and PM2.5.
The data are not comparable with national data bases at this time.

5) Do you have any suggestions for more effective graphic presentation of the data?
If yes, please describe.

Chinkin: Use same graphical techniques as other indicators (e.g. x,y plots).
Figure 200R-2 is not useful for display purposes (perhaps an average of statistically significant trend sites over time on an x,y plot)

Civerolo: Figure 200R-2 is difficult to read. How about replacing this figure with a table that lists the trend values, and the significant trends could be boldfaced, for example.

Fairley: Figure 200R-1 does not show trends. I actually think it's worthwhile to provide info on current concentrations of pollutants, but it seems inconsistent to do it in this case, and to exclude other indicators (such as the number of people living in areas that violate the NAAQS, for example) for the same reason.

Figure 200R-2 is a mess. The lines appear to be regression lines, rather than actual data. There is no indication what the length of the lines mean. A summary graph of some kind would be preferable.

Hidy: See above comments

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: If this indicator is to be included in the ROE, it would be useful to include a short discussion on why manganese concentrations appear to be decreasing or unchanging.

Fairley: Unless it can be demonstrated why manganese is a metal of particular concern, I would vote not to include it in ROE2006.

Hidy: The case is not made in the narrative for the choice of this regional indicator.

7) Overall, this indicator:

Chinkin: _X__ Should *not* be included in ROE06 TD.

Civerolo: __X_ Should *not* be included in ROE06 TD.

Fairley: __X_ Should *not* be included in ROE06 TD.

Hidy: __X_ Should *not* be included in ROE06 TD.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Ozone and PM for US/Mexico Border Countries**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (2) Indicator by definition is not nationally representative.

Civerolo: (2) Ozone and PM concentrations were covered in other chapters. In addition, this indicator applies to only parts of four states. It is not clear to me that this a both a national indicator, and is presenting information that are not presented elsewhere.

Fairley: (1) The discussion does not make clear why the ozone and PM along the US/Mexico border should be of any more concern that they are in other areas around the US that experience growth. The implication appears to be that the US may be affected by transport from Mexico, where air quality laws may be weaker. But the indicators chosen don't really address this issue.

Hidy: (2) This metric is a regional concern for trans-boundary conditions along the Mexico-US border. It is unclear why this is national interest. If so a similar analysis should be done for the Canadian border. The metric is of questionable appropriateness and utility. The measure is not considered adequate in terms of a trans-bundary index.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) While understanding AQ transport across international borders is important, this indicator is only using US data and thus precludes determining cross-border relationships.

Civerolo: (2) The period 1997-2003 is rather short to report trends. I wonder if it would be possible to have a chapter on general issues of transport across international borders; a large number of people live along the US and Canadian border, too.

Fairley: (1)

Hidy: (3) The importance of trans-boundary pollution conditions is increasing so that there may some merit in using this kind of index for national interest if done fairly north and south. The reasons are not given in the narrative for this choice, and should be discussed—O3 is one of many possible metrics.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (3)

Civerolo: (2) This is a very specific geographic region and time period, and I'm not sure such a specific analysis belongs in a national report (unless a number of areas are considered).

Fairley: (2) First, if the focus is the border itself, then the monitoring locations are not necessarily reflective of this. Second, a 6-year period is too short a time to establish any but very substantial air quality trends (as is pointed out in the "indicator limitations" section). The lack of any apparent trend may well be indicative of this.

Hidy: (2) The measurement is based on limited O3 data in a few counties along the Mexican border. The representativeness of this index is questionable. The exposure to populations along the border to O3 may be important locally, but questionable this is of national interest in terms of trends.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (1)
Hidy: (2)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (1)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (2)
Hidy: (1)

e) The data are comparable across time and space, and representative[16] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (2)
Hidy: (1)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

Please explain:

Chinkin: [no answer provided]

Civerolo: It isn't that the analysis is not important or useful, I'm just not sure it adds enough new information that isn't included in other chapters.

Fairley: d) Data series is too short to detect any but gross trends.

e) What is the target population? What is the question this indicator addresses?

Hidy: The indicator has questionable importance as an exposure metric. The choice has questionable objectivity and motivation. The collection of data is not representative of the border conditions since it only includes a few counties and does not cover the border region adequately.
The data are limited for space and time comparisons, and the use of the data is not transparent.

[16] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Use trend plots like those by EPA region for other indicators except at the county-level along both sides of the border

Civerolo: [no answer provided]

Fairley: [no answer provided]

Hidy: [no answer provided]

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: [no answer provided]

Fairley: I am not convinced that this indicator addresses an issue of environmental concern for the US. The general question of the extent to which the US is affected by transport or affects other countries is of concern, but is a difficult issue to address.

The response to T2Q2 appears an attempt to answer why this system was set up: "The prime rationale for siting the existing … monitors in the border zone was to determine air pollution exposures in populated areas. A secondary rationale was to supply trends information for sensitive ecosystems." This could apply to *any* air quality monitoring. It doesn't convince me that there is something unique about these data.

Hidy: The narrative needs to go into more detail about the chemistry involved. The metric is difficult to understand for the lay person, and needs relevance to air quality in U.S. needs to be discussed further.

7) Overall, this indicator:

Chinkin: _X__ Should *not* be included in ROE06 TD.

Civerolo: __X__ Should *not* be included in ROE06 TD.

Fairley: __X__ Should *not* be included in ROE06 TD.

Hidy: __X__ Should *not* be included in ROE06 TD.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Ozone Levels Over North America**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3) Stratospheric ozone concentrations are an important indicator of public health issues.

Civerolo: (3) This will continue to be an important indicator for decades to come, since the lifetimes of ozone-depleting substances are on the order of years to decades (or longer). It will be important to monitor improvements in stratospheric ozone as these substances are phased-out. The health effects associated with increased UV radiation at the earth's surface are well-documented.

Fairley: (3) Including this indicator seems useful, at the least to attempt to make the distinction between ground-level ozone and stratospheric ozone. However, it isn't made clear how this indicator translates into exposure and health effects. The "what the data show" section says there's been a 3% decrease in "total column ozone" compared with pre-1980. How does that affect the amount of harmful UV coming through? Is there a relationship with skin cancer?

Hidy: (2) O3 over NA is an unusual indicator of air quality for the U.S., except for Alaska. It concerns stratospheric O3, and is really a global pollution impact indicator. The indicator is of great scientific interest, but may not be an important metric for the public in general. The measure may not be adequate as an interpretable metric for the mid-latitudes since the O3 depletion phenomenon is mainly in the polar regions.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3)

Civerolo: (3) Please see above comments. It will likely be decades or longer before the importance of ozone depletion is diminished.

Fairley: (4)

Hidy: (3) Relative to other measures of air quality in the U.S. per se, the issue of stratospheric ozone depletion is likely to be of minor importance to general public. Nevertheless, it is an important question for issues of global pollution and the continued emission of CFCs worldwide.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (4)

Civerolo: (3) The time series in ozone layer thickness is sufficiently long (~25 years or more) to elucidate trends in this parameter, at least at a few locations.

Fairley: (4)

Hidy: (3) The indicator is based the TOMS satellite measurements in combination with ground based photometer measurements at four US stations. The data are reported in Dobson units, which are relatively difficult to interpret without careful explanation. The link with exposure and health is exclusively to modification of uv-b radiation at the ground, and narrowly links with skin cancer for humans and vegetation damage in a limited way.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (None)
Hidy: (3)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

e) The data are comparable across time and space, and representative[17] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (4)
Hidy: (3)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

Please explain:

Chinkin: [no answer provided]

Civerolo: It would help the reader to give a sense of how consistent the measurement techniques have been over the past 25+ years. Because ozone layer thickness is highly variable over a given year, and reported changes are on the order of a few percent, it is critical that the measurement methods did not change. I also wonder if reporting ozone layer thickness at four locations is representative of the entire nation; it may very well be. Are there other locations in Europe, Asia, etc. to suggest that the changes observed over North America are generally consistent with those observed elsewhere?

Fairley: [no answer provided]

Hidy: Stratospheric O3 depletion especially at the poles is an important measure of global pollution. In the narrative there appears confusion about the TOMs data vs. the surface based photometer data—I think that the graph is the photometer data at the four baseline sites. The mid-latitude loss of O3 shows a weak signal in the 80s which is followed by a leveling effect. This should be linked with HFC changes in emissions worldwide.

[17] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

The data are reliable both from the satellite and from the ground, and reflect a global scale spatial and temporal phenomenon. The data are well documented and use well established measurement methods.
The interpretation of the Dobson Unit is obscure to the lay person and needs to be explained.

5) Do you have any suggestions for more effective graphic presentation of the data?
If yes, please describe.

Chinkin: Show annual average trends like other indicators, thus making trends more clearly seen (e.g. ground-level ozone peaks in the summer, but normally its trends are shown as annual statistics).

Civerolo: The ozone layer thickness exhibits a strong seasonality. It might be possible to estimate a trend in, say, the minimum thickness occurring during the fall months in the Northern hemisphere (peak of the ozone hole), rather than show the thickness throughout the year. Also, the colors used make Figure 015-1 difficult to read; perhaps it can be redone with better contrasting colors.

Fairley: The large annual swings make trend comparisons difficult. How about adding a 4-site moving annual average?

Hidy: Perhaps a satellite based polar projection would be useful to get a perspective on the ozone depletion that is really important. It's important to the conditions at higher latitiudes in Alaska and Canada, but how consequential to human health is problematic.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: [no answer provided]

Fairley: In the "what the data show" section it isn't apparent from the graph that "total ozone measurements…declined" in part because the data include the large seasonal swings. It would be useful to include an annual moving average. Also, this is descriptive, not scientific. Was the downtrend from 1979-1993 statistically significant? How large was it? What has the trend been since 1993?

All the "Response/Question" section seems devoted to the TOMS data. But in the "indicator limitations" section it says that *three* data sources are used. I note that there appears to be a data gap in the TOMS data from 6/93 to 7/96. How was the ozone layer thickness determined for this period?

Also, I found what appears to be the same graph at:
http://www.cpc.ncep.noaa.gov/products/stratosphere/winter_bulletins/nh_04-05/figure_05.gif
It says these are "total ozone measurements from four mid latitude U.S. Dobson instruments."
So what does all this have to do with satellites??

Hidy: The narrative should go into the halogen-O3 chemistry in more detail to give the reader more perspective on the significance of these measurements.

7) Overall, this indicator:

Chinkin: __X_ Should be included in ROE06 TD with the modifications identified above.

Civerolo: __X__ Should be included in ROE06 TD with the modifications identified above.

Fairley: __X___ Should be included in ROE06 TD.

Hidy: __X__ Should be included in ROE06 TD with the modifications identified above.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Concentrations of Ozone-Depleting Substances**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (2) Indicator does not include sufficient compounds to be truly representative (e.g., missing almost 50% of current estimate).

Civerolo: (3) Tracking changes in EECl is important to monitor the progress of the Montreal Protocol and the phasing-out of these compounds. As long as we are monitoring the ozone layer thickness, we need to pay attention to levels of EECl in the atmosphere.

Fairley: (4) This indicator is a useful complement to "ozone levels over North America." Although this indicator represents a world-wide average, it is appropriate in showing the potential for continued destruction of stratospheric ozone; this is a global, not US problem.

Hidy: (2) O3 depleting substances is a different indicator from others adopted in this project. It deals with the effect of CFC on O3 in the stratosphere as a metric. This is an appropriate and useful global measure of air quality, but may no be adequate in terms of its recognized relationship to populations at the ground in the U.S. The CFCs *per se* are not a health hazard or a ecological hazard to populations in the U.S. at ambient concentrations.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3)

Civerolo: (3) Monitoring EECl at ground-level is important, but needs to be combined with occasional monitoring efforts in upper troposphere or stratosphere (where ozone depletion is occurring). This requires aircraft work, unless there are ways to estimate CFC levels remotely.

Fairley: (4)

Hidy: (3) This indicator is important to link to the global health of the atmosphere in that CFCs are a major factor in modulating stratospheric O3.

3) To what extent do you think the indicator meets the following indicator definition:

*An "indicator" is **a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition** over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (2)

Civerolo: (2) Trends in EECl are indicative of how halogenated compounds are changing as a whole; however, as indicated in the limitation section, it is only a proxy that may be somewhat uncertain. Also, the text indicates that Cl compounds are generally increasing while Br compounds may be increasing; it will be important to report trends in the different classes of compounds, since it is not clear that EECl will continue to decrease at the stated rate.

Fairley: (4) I'm unfamiliar with these data, but did look at graphs broken down by sampling site. The concentration curves are remarkably similar from the US to Australia to the South Pole. Thus, they may well be representative of the trends globally.

Hidy: (2) The indicator concerns changes in CFC emissions, which affect global stratospheric O3 conditions. The linkage to human exposure and health effects is somewhat obscure.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (4)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (None)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

e) The data are comparable across time and space, and representative[18] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

[18] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (4)
Hidy: (2)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

Please explain:

Chinkin: [no answer provided]

Civerolo: I don't have a feel for how representative EECl concentrations at 5-7 remote locations are of levels over North America or the globe.

Fairley: [no answer provided]

Hidy: The indicator is important for monitoring change in the global stratosphere, and reductions in CFCs affecting O3. Other indexes (pesticides) may be better indicators for tropospheric conditions. The data are difficult to understand in terms of concentrations at the ground, since primary interest are conditions integrated throughout the troposphere into the lower stratosphere. Interpretation of the data is not transparent, and the graph is not particularly helpful to the reader to understand what is going on with such reductions.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Figure implies a decrease in concentrations over time, but the text implies that amount of certain important compounds are still increasing.

Civerolo: [no answer provided]

Fairley: [no answer provided]

Hidy: I'm surprised that the reductions are so small since the Montreal protocol. The world emission must still be large for CFCs. This may need an explanation relative to US emissions.

It would be useful to include a graph showing the CFC or EECI emission reductions here, or CFC concentration changes in the high atmosphere.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: [no answer provided]

Fairley: [no answer provided]

Hidy: The narrative needs to go into more detail about the chemistry involved. The metric is difficult to understand for the lay person, and needs relevance to air quality in U.S. needs to be discussed further.

7) Overall, this indicator:

Chinkin: __X__ Should *not* be included in ROE06 TD.

Civerolo: __X__ Should be included in ROE06 TD with the modifications identified above.

Fairley: __X___ Should be included in ROE06 TD.

Hidy: __X__ Should be included in ROE06 TD with the modifications identified above.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Atmospheric Deposition of Mercury**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3) Mercury has known public health effects.

Civerolo: (3) The health effects of mercury are well-known, and this indicator should be included in the ROE. Mercury wet deposition is measured with relatively good spatial resolution in the eastern US, but efforts need to be stepped up in the western US.

Fairley: (3) Although there are obvious similarities to the manganese indicator, I believe this indicator comes closer to being appropriate for ROE2006, because the network is nation-wide, and appears designed to be representative of large areas. However, I have a concern that there is only an indirect connection between this indicator and human health. Specifically, to what extent do the patterns of mercury deposition reflect mercury uptake in fish and humans?

Hidy: (3) Hg is generally a good choice for an indicator because of the great public interest at the moment. The measure is appropriate and useful as an indicator of a potentially important HAPS. The adequacy of the metric can be challenged on the basis of limited measurements, that do not report speciated Hg, and the linkage with health effects which involves the food chain through consumption of fish. This is an exposure which is highly controllable by diet, and affects an unknown but presumably small segment of the U. S. population.
The indicator needs to be explained in the light of the fact that Hg is a global pollutant on which a small annual tonnage of U.S. emissions are superimposed.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3)

Civerolo: (3) As the national monitoring efforts continue, we will be able to estimate trends in wet deposition of Hg. However, since there is an abundance of "background" mercury in the atmosphere, it may be hard to link changes in deposition with changes in emissions (since on a national or global basis, small changes in "new" emissions may be masked by variability in the background levels).

Fairley: (3) This is one among many potential environmental contaminants. Unlike most, there is a widespread network to measure it, with monitors located to represent broad areas.

Hidy: (3) The current public concern for Hg contamination indicates the importance of this metric even though the national emissions are very low relative to the overall pool of Hg in the environment.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (3) Indicator should account for dry- as well as wet-deposition.

Civerolo: (3) The time record for wet deposition data is relatively short (< 10 years), so it is difficult to estimate trends in the data. The data can be used to examine spatial patterns, at least in the eastern US.

Fairley: (1) As it stands, it doesn't "represent or draw attention to underlying trends." This could be remedied by looking at trends in the set of sites that have been in operation since 1995.

Hidy: (2) The indicator is based on measurements of wet deposition of Hg, and concentration of Hg in precipitation. There is only an indirect estimate of total deposition. The exposure to health issue through the food chain is not discussed, nor are there any metrics that reflect the fish consumption and effect on population.
Speciation may be a factor in exposure as well since MeHg is the key toxin.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (3)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (2)
Hidy: (1)

e) The data are comparable across time and space, and representative[19] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (2)
Hidy: (2)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

Please explain:

Chinkin: [no answer provided]

Civerolo: Mercury is a multi-media pollutant. While the national monitoring program characterizes Hg levels in precipitation, it cannot provide information on levels in the oceans, ecosystems, fish/wildlife. Wet deposition is an element of the mercury cycle in the environment, but I don't know how important a loading it is compared to dry deposition, re-emissions from water bodies, etc.

Fairley: d) and e) There are no trends shown. It is unclear how the deposition of mercury correlates with human health concerns.

Hidy: The indicator is perceived to be important from the public standpoint (largely from EPA focus and media attention).
The maps showing the Hg distribution of deposition are straight forward but do not reflect any concern for natural large scale transport heterogeneities that would influence these distributions. It is not clear how the maps are generated from such few observational sites. There is minimal coverage in the West, where presumably much of the deposition is dry. The Pacific Coast values

[19] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

are quite variable, their range should be explained in the figure. High levels of Hg deposition are recorded in the Gulf Coast region. This needs to be interpreted for the reader since most of the coal emissions are further north. The band of weak deposition just east of the Ohio River Valley does not make sense if long range transport is a factor.
There is no trend data presented that accompanies the apparent differences in Hg emissions. The data are presumed to be reliable even though the measurements are tricky. The data are transparent but of unknown reproducibility.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Indicator should use same plot style as other indicators, regression trends over time in each region of the nation.

Civerolo: [no answer provided]

Fairley: The graphs are effective.

Hidy: [no answer provided]

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: The title of this indicator should probably be “Wet Deposition of Mercury” since estimates of dry deposition are few and far between.

Fairley: The first sentence says that mercury is both naturally occurring and also emitted from industrial processes, but it gives no indication of the relative magnitude of the effect. Don't anthropogenic emissions dwarf non-anthropogenic? Or are we being "fair and balanced" here?

In the "what the data show" section it says "Wet deposition is a better measure than concentration of the amount of mercury that goes into the environment through precipitation." But in the "indicator limitations" section it says that dry deposition may "make up a substantial portion of the total amount deposited." The key issue is the total, correct? If so, is concentration is a better gauge than wet deposition in estimating the overall environmental impact?

This is another indicator that doesn't indicate a trend. I note that data appear available for a number of sites from 1996 through 2004. Would it be possible to include some estimates of trend for this indicator?

Hidy: [no answer provided]

7) Overall, this indicator:

Chinkin: __X_ Should be included in ROE06 TD with the modifications identified above.

Civerolo: __X_ Should be included in ROE06 TD with the modifications identified above.

Fairley: __X__ Should be included in ROE06 TD.

Hidy: __X_ Should be included in ROE06 TD with the modifications identified above

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Acid Deposition**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3)

Civerolo: (4) Acidic deposition continues to be an environmental problem across much of the eastern half of the US, particularly in the Midwest and Northeast, although levels are generally decreasing in these regions. Its precursors are related to other air quality problems, such as ambient particulate matter and reduced visibility.

Fairley: (4) The introduction lists numerous environmental problems associated with sulfate and nitrate deposition. This indicator provides a clear picture of the problem.

Hidy: (3) Generally this is an appropriate and useful metric for deposition of acid species. The calculation of dry deposition from ambient concentration data is the Achilles' heel of the method. The indicator narrative should be specific that the ecological stress is on a very limited set of systems in the East and the Rocky Mountain alpine region. This is not a geographically general adverse phenomenon.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3)

Civerolo: (3) The importance of this indicator has not diminished, and deposition will continue to impact the northeastern US as long as there are sufficient levels of precursor (SO_2 and NOx) emissions. The data also can be used to track the effects of emissions control programs such as Title IV.

Fairley: (4)

Hidy: (3) The indicator is an important metric because of continuing public interest in stress of certain sensitive aquatic and terrestrial ecosystems, as well as concerns for material damage, including erosion of historical architectural sites.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (3)

Civerolo: (3) Please refer to my previous comments. These data show that improvements have occurred over much of the eastern US over the past 15+ years.

Fairley: (4)

Hidy: (3) The indicator is based on direct measurements of wet deposition and calculations of dry deposition, which have theoretical bases. The translation to exposure and ecological or other effects is less specific in the narrative. The narrative should be specific about the apparent stress on certain sensitive ecosystems, not generally across the country. The issue of is likely to be important, but the enhancement of Hg exposure in aquatic systems may be a minor overall feature of acid deposition. Enhancement of eutrophication in aquatic systems is a contribution factor, but has to be weighed against agricultural and land use in areas like Chesapeake Bay. However, may be more significant in a few cases documented in remote pristine low alkalinity watersheds.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

e) The data are comparable across time and space, and representative[20] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (None)
Hidy: (3)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

Please explain:

Chinkin: [no answer provided]

Civerolo: My only comment is that it might be useful to consider showing concentrations of sulfate and nitrate in wet deposition, rather than wet deposition itself. Wet deposition can be variable from year to year as a result in variations in precipitation. Hence, a comparison between wet deposition amounts at two points in time may not reflect what was really going on during the intermediate years.

Fairley: e) The indicator shows an average across long-running sampling sites. There is no necessary correlation between the site locations and population.

Hidy: Acid deposition is perceived to be an important metric of air pollution in remote areas. The wet deposition data are well established in method and laboratory analysis and represent a long term monitoring for changes in acidic species deposition. The calculation of dry deposition is more problematic, especially for application to rough terrain.

[20] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

The data are generally comparable spatially and temporally, and the results are transparent and reproducible.
The trends reflected in the data include sulfate and nitrate, which are controlled under Title IV of the CAA.
Progress has been made on deposition, but there is little or no information provided to the reader on the effects on sensitive lakes and streams or forests over the same time period.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Indicator should use same plot style as other indicators, regression trends over time in each region of the nation.

Civerolo: The figures are hard to read. For Figures 011-1 and 011-2, I would remove the deposition values listed on the figures – just use color. Can Figures 011-3 and 011-4 be done this way as well, or is there a reason that the relative wet/dry contributions to total deposition are shown? If the relative wet/dry contributions are consistent everywhere (more or less), then the text could be changed to reflect this. It's hard to tell from the figures, but it appears that wet and dry deposition each contribute about half to the total. If it appears that the relative ratio of wet to dry deposition is changing, then it would help to add a sentence or two about why this might be happening.

Fairley: [no answer provided]

Hidy: The graphs as presented in the draft are impossible to read.
The presentation of results geographically needs to be much easier to look at.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: [no answer provided]

Fairley: Last sentence of paragraph 2 – "increased levels of sulfate in ground-level air…can contribute to decreased visibility as well as a variety of human health problems." I believe this would be true for nitrate as well.

Hidy: [no answer provided]

7) Overall, this indicator:

Chinkin: __X__ Should be included in ROE06 TD with the modifications identified above.

Civerolo: __X__ Should be included in ROE06 TD with the modifications identified above.

Fairley: __X___ Should be included in ROE06 TD.

Hidy: __X__ Should be included in ROE06 TD with the modifications identified above.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Visibility**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3) Visibility is perhaps the indicator best-understood by the public

Civerolo: (3) Visibility impairment at Class I areas is closely linked with fine particulate pollution, and many states have Class I areas that will need to meet regional haze/visibility goals in the future. It's not a human health issue though, it's more human welfare.

Fairley: (3) The indicator is based on a high-quality and geographically extensive monitoring system.

Hidy: (3) This indicator is a prominent metric for air pollution. The indicator is appropriate and useful as a measure of visual impairment and air pollution. The metric relies on a calculation from PM2.5 composition data and extinction efficiencies, and focuses on Class I areas. Additional discussion of airport visibility or transmissometer data would give an urban perspective that would be helpful.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3)

Civerolo: (3) This indicator illustrates how the best, mid-range, and worst visibility conditions are changing over the past decade, albeit in a pretty coarse way (east vs. west, as opposed to EPA regions as has been done for several other indicators).

Fairley: (3) Although this indicator deals with an esthetic issue, it is one that people care about.

Hidy: (3) The indictor is an important measure of air pollution from an aesthetics viewpoint, and is of great interest to the public. In general visibility is most strongly related to PM2.5, but also can be affected by NO2 concentrations. The latter is generally not considered.

3) To what extent do you think the indicator meets the following indicator definition:

*An "indicator" is **a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition** over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (2) Indicator is not really visibility, rather an estimate based on an equation of assumed visibility impacts of filter-based PM mass measurements.

Civerolo: (2) Please clarify why only 47 sites were used in this analysis, and how many of these were in the eastern and western halves of the country. Also, as it states in the text, this is not actually a measurement of visual range that most people are familiar with; it is a metric based on coarse and fine particulate concentration data.

Fairley: (4)

Hidy: (2) The metric is a quantity derived from PM2.5 composition and light extinction efficiencies. There are subtle assumptions in this calculation which are generally not appreciated by the lay reader. A direct measure of extinction or light contrast would be more appropriate. The link with human effects is in terms of aesthetic impression, which is distinct from any health effect or ecological stress.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (2)
Fairley: (4)
Hidy: (2)

e) The data are comparable across time and space, and representative[21] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

[21] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Chinkin: (2)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

Please explain:

Chinkin: Indicator is for rural areas of the US, not urban areas where most people live and see the impacts of changes in visibility daily.

Civerolo: Please refer to my earlier comments.

Fairley: e) The target in this case is national parks. The monitoring system is an extensive & is likely to be reflective of visibility levels and trends at all national parks.

Hidy: The indicator is an important adjunct to the Regional Haze Rule, and is an important measure of change in air quality values in pristine areas. .The results are reported only for the Class I areas from measurements at the IMPROVE sites. The calculations are commonly accepted as a measure of light extinction, but they are not fail- safe. The data are generally comparable in time and space, and are documented for QC/QA. The results are not transparent, but are reproducible. The method does not give insight into geographical varying conditions, which the IMPROVE investigators have done, nor does it say anything about urban visibility trends associated with air port visibility or transmissometer data.

5) Do you have any suggestions for more effective graphic presentation of the data?
If yes, please describe.

Chinkin: Indicator should use same plot style as other indicators (best=90th percentile, etc.), regression trends over time in each region of the nation.

Civerolo: The visual range plots could be updated through 2003. It's hard to tell with any certainty, but it appears that the best visibility conditions might be increasing. Perhaps two additional years of data would help show this.

Fairley: The graphics could be improved. There appears to be little trend; the way the graphs are done, it's hard to see what trend there is. Maybe simple bar charts comparing 1992 with the most recent year would be better.

Hidy: The results are not very enlightening, especially with PMx data showing a trend and thee data do not. The geographical trends given by the IMPROVE investigators should be include, and an attempt should be made to address urban visibility impairment as noted by airport visibility and transmissometer data.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: A limitation of this indicator that should be listed under "limitations" is that the visual range data presented in this figures is not measured directly, rather it is estimated from 24-hour speciated particulate concentrations every three days. Also, if this section is to focus on reduced visibility in Class I areas, it might be more appropriately labeled "regional haze," to distinguish it from urban visibility impairment.

Fairley: Aren't there direct visibility measurements? Why was an indirect measure used instead?

Paragraph 2 of the introduction should mention that ammonia is the other precursor to ammonium sulfate and ammonium nitrate.

Paragraph 3 talks about the main sources of visibility impairment in the eastern US, but not the west.

In the "what the data show" section, there is no word on what the trends have been, if any. The results should be stated, whether or not the trends are significant.

The text explains how the best and worst visibility conditions are defined, but how is the midrange defined?

Hidy: [no answer provided]

7) Overall, this indicator:

Chinkin: __X_ Should be included in ROE06 TD with the modifications identified above.

Civerolo: _X___ Should be included in ROE06 TD with the modifications identified above.

Fairley: __X__ Should be included in ROE06 TD.

Hidy: _X___ Should be included in ROE06 TD with the modifications identified above.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **U.S. Greenhouse Gas Emissions**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (2) Greenhouse gas emission estimation methods are still in their infancy compared to criteria pollutants.

Civerolo: (3) This indicator important to understanding the human-induced portion of global climate change (at least the US's role in this), although I would be curious to see what the emissions were prior to 1990.

Fairley: (4)

Hidy: (3) The CO2 emissions data are appropriate and useful as a measure of the continuing use of fossil fuel in the U.S. relative to the rest of the world, and the issue of climate alteration. In themselves the data are not adequate to provide a metric of air quality or climate alteration, but the data are part of the story. The methane emissions are also important to track. There is no data on N2O, which also has long terms trends of importance.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) Global climate change is a serious concern.

Civerolo: (3) This indicator lists emissions, in terms of global warming potentials, of the most abundant greenhouse gases. When weighted by global warming potential, I am not sure how important it is to consider CFCs and HCFCs (which are not considered here), as well as other gases and particulates.

Fairley: (4) Climate change is far and away the number one environmental concern facing our species. Of all the indicators being considered, these data on GHG emissions and atmospheric concentrations are the most important.

Hidy: (4) The measure of GHG from U.S. sources is an important index for the U.S., contributions to these gases, and associated issue of climate alteration. The U.S. public needs to continue seeing this issue raised as a long term air quality stress, not only for CO2, but for methane, and N2O from agricultural soils and synthetic fiber production.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (2) Emission inventories (especially for many greenhouse gas sources such as leaks are very difficult to quantify accurately) are based on a variety of estimated inputs; not direct measurements except for power plants and some on-road mobile sources.

Civerolo: (3) This indicator illustrates recent trends in greenhouse gas emissions in the, but it would help to put these emissions in context with emissions from other countries/continents since all emissions affect human-induced global warming.

Fairley: (1) These are not actual measurements so, technically, it doesn't meet the first part of the definition.

Hidy: (3) The estimates of national scale emissions are well documented in terms of CO2 from the quantity and type of fuel burned. Methane is more problematic, though the U.S. emissions are probably better known that most countries. The emissions of N2O are more problematic because of their diffuse sources, but still are problematic-quantitatively reliable. The linkage to health effects and ecological stress are more difficult to pin down, and represent a significant disagreement in relation to U.S. concerns. Nevertheless the concerns are real for climate alteration, and need to be taken into account in the long term.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (4)
Hidy: (3)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (None)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

e) The data are comparable across time and space, and representative[22] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

Please explain:

Chinkin: Emissions estimates are not complete enough to be representative.

Civerolo: Again, the only limitation I see is that a number of radiatively important substances like CFCs, HCFCs, and some aerosols were not included here. Perhaps this should be explored in a future ROE, if inclusion of these substances is above and beyond the scope of this report.

Fairley: a) Because virtually all the carbon in fossil fuels is converted to CO2 through combustion, and because the combustion characteristics of various fossil fuels are well-known, CO2 emissions, which constitute the lion's share of the emissions even on a CO2 equivalent basis, will be well-estimated. In this case, the target population is everyone. The climate change resulting from US GHG emissions is world-wide, as are the emissions from other countries.

Hidy: The indicator is an important measure of the GHG emissions in the U.S. relative to the rest of the world. The national data for CO2 emissions is carbon fuel based and is well documented. Data for methane and for N2O are much less reliable and need to taken as semi-quantitative. The trends reported are somewhat problematic for these two gases.

[22] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

The data for methane and for N2O are not necessarily transparent, and may not be reproducible.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Recommend present as area line graph like other emission trend plots.

Civerolo: The four figures are somewhat difficult to read. Please consider redoing them with higher resolution and maybe some color. Also, will the figures be updated to 2003 or 2004?

Fairley: [no answer provided]

Hidy: The graphics in the draft are poor quality and need to be improved for the final drafting.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: [no answer provided]

Fairley: Most of the other sections talk about the negative effects of the respective indicators. Where is the description of the numerous known and likely future effects of global warming? I consider this a serious omission. Scientific studies of these effects come out almost daily. In the past couple of days I've read that global warming has already contributed to droughts in many parts of the world that have led to serious food shortages. There was a report today that the excess CO2 is causing the oceans to become more acidic, which is destroying coral reefs and undermining the ocean's food chain. Last summer an estimated 10,000 people died in France from an unprecedented heat wave. From the Arctic to the Antarctic, glaciers are melting, affecting not just the local environment, but also sea level and water salinity. The list goes on and on. Yet this report mentions nothing about this.

The introduction should make it clear that CO2 emissions differ fundamentally from other pollutants in that they are the inevitable result of burning fossil fuels. People may think that we just need the equivalent of a catalytic converter to reduce them, but the reality (as I understand it) is that there is no known way to sequester these emissions, that the only way available is to reduce the use of fossil fuels.

In the "what the data show" section it should explain that electricity generation produces greenhouse gases only if it's being generated by fossil fuels – natural gas and coal – not from hydro, nuclear or renewables.

The "what the data show" section says "Across economic sectors, the largest source of greenhouse gas emissions in the US is combustion of fossil fuels (Figure 348-3)." This is an extremely important point, but this figure doesn't show it, which makes this explanation

confusing. This point should be made in the 1st paragraph, which deals with Figure 348-1 and is also introductory. I suspect that many people are confused about global warming & don't realize that fossil fuel burning is the major culprit. This is a point that should be made patently clear.

In paragraph 3 of the "what the data show" section, it says that transportation is the largest "emitter of fossil fuel CO2 emissions." This seems to contradict the statement in paragraph 2 that "electricity generation has consistently been the largest producer of GHG emissions. I think the point is that these are comparisons of end-use sectors. This could be made clearer.

Hidy: [no answer provided]

7) Overall, this indicator:

Chinkin: _X_ Should be included in ROE06 TD with the modifications identified above.

Civerolo: _X_ Should be included in ROE06 TD with the modifications identified above.

Fairley: _X_ Should be included in ROE06 TD.

Hidy: _X_ Should be included in ROE06 TD.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **Atmospheric Concentrations of Greenhouse Gases**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (4)

Civerolo: (4) This indicator is very illustrative of ambient concentrations of important greenhouse gases, and the rise of these substances during the Industrial Age. Also, the seasonal variability in these concentrations is evident in the most recent record

Fairley: (4)

Hidy: (3) The change in greenhouse gas concentrations is an appropriate, and useful indicator, and the data are adequate to show trends in these pollutants of global concern.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) Global climate change is a serious concern, but concentrations over US reflect global contributions not just US contributions.

Civerolo: (3) Global change will be an important environmental concern for years to come, and ambient concentrations of greenhouse gases will continue to be monitored. However, as I stated in my review of the emissions of greenhouse gases chapter (348), this is a global issue, and ambient concentrations of these substances are influenced by emissions from outside of the US as well.

Fairley: (4) Climate change is far and away the number one environmental concern facing our species. Of all the indicators being considered, these data on GHG emissions and atmospheric concentrations are the most important.

Hidy: (4) This is key measure of change in global pollutants that needs to be addressing the ROE questions.

3) To what extent do you think the indicator meets the following indicator definition:

*An "indicator" is **a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition** over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (3) Emission inventories (especially for many greenhouse gas sources such as leaks are very difficult to quantify accurately) are based on a variety of estimated inputs; not direct measurements except for power plants and some on-road mobile sources.

Civerolo: (3) Please refer to my previous comment.

Fairley: (4) GHG concentrations are considered the drivers of global warming.

Hidy: (3) The gas measurements are made at globally representative stations in the U.S. and elsewhere. The results rely on well established methods of measurement, and give a direct indication of trends in these largely non-reactive gases in the troposphere. The link with health effects and ecological effects is still somewhat problematic because of the long term changes in climate (natural and forced).

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (4)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (2)
Fairley: (4)
Hidy: (3)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

e) The data are comparable across time and space, and representative[23] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

[23] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

Please explain:

Chinkin: [no answer provided]

Civerolo: In the text, it states that rates of increase of methane have slowed to almost zero in recent years. I'm not sure that Figure 349-2 shows this, but even if this is true, I'm not sure this can be extrapolated into the future.

Fairley: e) In this case, the target population is everyone. The climate change resulting from US GHG emissions is world-wide, as are the emissions from other countries.

Hidy: This is an important measure that has widespread national and international public interest. The measurements are well established, and need not reflect spatial differences. The temporal change and trends recorded are regarded as definitive, and the QC/QA effort on these measurements are substantial. The increases are well documented; the consequences remain problematic.

5) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Enlarge figures.

Civerolo: Figures 349-1 and 349-2 include panels for CO_2 and CH_4 that show ambient concentrations going back hundreds of thousands of years. These panels are probably not necessary since there is very little discussion in the text on such time scales. The panels appear to be labeled incorrectly; in Figures 349-1, for example, the panels from left to right appear to read (d), (b), and (a).

Fairley: This is a nice set of graphics. I note that the CO2 graphs all have the same y-axis. I think this would be useful for the CH4 axis as well – it would make the concentrations on the three time scales easier to compare. Ditto for N2O.

Why are the subfigures in 349-1 labeled d), b) and a) in that order?

Hidy: The graphics in the draft are difficult to read.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: [no answer provided]

Civerolo: Some greenhouse halocarbon concentrations are included here, whereas they were not included in the greenhouse gas emissions chapter (348). I would suggest adding some halocarbon information to the emissions chapter.

Fairley: As discussed on the GHG emissions evaluation sheet, there needs to be a discussion of the present and potential effects of climate change!

In the "what the data show" section, there should be more explanation of what "geological time" is. If I'm reading the chart right, estimated CO2 concentrations go back about 400,000 years, correct? Putting Figure 349-1 d) and b) together, the increase in CO2 is especially impressive. Also, the statement that the concentrations have "varied considerably" should be clarified, since the range, apparently, has been consistently well below what it is today.

Hidy: [No answer provided]

7) Overall, this indicator:

Chinkin: _X_ Should be included in ROE06 TD with the modifications identified above.

Civerolo: _X_ Should be included in ROE06 TD with the modifications identified above.

Fairley: _X_ Should be included in ROE06 TD.

Hidy: _X_ Should be included in ROE06 TD.

Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Air**
Indicator Name: **U.S. Homes Above EPA's Radon Action Level**

1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (2)

Civerolo: (3) Radon appears to be one of the more important indoor air quality issues facing many Americans today, but I don't know how important it is compared with other factors such as smoking. I am not too familiar with indoor air issues, and would defer to someone who is more knowledgeable.

Fairley: (3)

Hidy: (2) There is a major question of relevance to the intent of this report. Radon is a concern for indoor air and not ambient air. If the decision is made to include this, then the metric is appropriate and useful. The metric may not be adequate in terms of radon exposure to the national population.

2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (2) Indicator is important for some regions of the nation only.

Civerolo: (3) Please see above comment. This will continue to be an important issue as new houses are continually being built.

Fairley: (3) As mentioned in the introduction, radon causes lung cancer in thousands of Americans each year. It is certainly a serious health risk.

Hidy: (3) With the caveat about relevance, the metric is probably important.

3) To what extent do you think the indicator meets the following indicator definition:

An "indicator" is ***a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition*** *over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (1) Indicator is based on assumptions not direct measurements.

Civerolo: (3) This indicator tracks the absolute numbers of homes with "high" radon levels and homes with mitigation systems. This is fine, but it might help to discuss what the trends in the percentage of homes with high radon/mitigations are.

Fairley: (3) Although not explained in the text that I saw, radon concentrations have been made in thousands of homes and, presumably are the basis for the estimated # of homes with elevated radon levels.

Hidy: (2) Unclear whether this metric is relevant. If it is then the numerical measures are satisfactory, but the link with exposure and lung cancer incidence is problematic.

4) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (3)
Hidy: (3)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (2)
Hidy: (2)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (2)
Hidy: (2)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (3)
Hidy: (2)

e) The data are comparable across time and space, and representative[24] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (3)
Hidy: (2)

[24] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (3)
Fairley: (None)
Hidy: (2)

Please explain:

Chinkin: [no answer provided]

Civerolo: You may want to include a figure that shows radon levels across the country, to give a sense of where the trouble spots/regions are, and where mitigations are most needed.

Fairley: b) and c) Although the estimates of # of homes with elevated radon levels may be valid, the explanations provided were inadequate. In response to the question whether appropriate statistical methods were used to generalize the data beyond the spatial locations where measurements were made, the response was "Not Applicable". Are they claiming that radon measurements have been made in every house in the US?

Hidy: This is a potentially important indicator for (indoor) air quality. The measurements are reasonably sound, but it's unclear how EPA actually gets the determinations of radiation and the mitigation. The data presumably are measured in terms of radioactive emissions so that they are reliable if the detector is calibrated properly.
Relevance to this report is an agency judgment call.

5) Do you have any suggestions for more effective graphic presentation of the data?
If yes, please describe.

Chinkin: [no answer provided]

Civerolo: I believe the y-axes should read thousands of mitigations and thousands of homes (> 4 pCi/L).

Fairley: The graph is somewhat misleading, making it look like almost all the houses with elevated radon levels have been mitigated. In fact, it's still less than 10%, right? I would use the same scale for both mitigations and homes with elevated levels.

Hidy: [no answer provided]

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: Indicator does not reflect trends in text (e.g., Number of homes above threshold are rising faster than mitigation measures).

Civerolo: It appears that radon and blood cotinine levels are the two indoor air quality issues in this ROE. I don't know if this is sufficient to cover indoor air quality, but would not have any suggestions for additional indicators.

Fairley: There should be more explanation of exactly how the estimates for the number of homes with elevated radon levels was made. To what extent was it based on a systematic survey of home radon concentrations? Are extrapolations based on underlying geology? How many homes were tested? When? Is there an ongoing program? Are homes that have had radon mitigation measures taken been systematically measured?

The 3rd paragraph discusses an "action level" of 4 pCi/L. Is this a long-term average or a short-term one?

In the 3rd paragraph of the introduction, there's a sentence that isn't clear to me: "Typically, a home is mitigated based on the average of two radon measurements for real estate transactions." Why two? Over what period are the measurements made? Isn't there some variation over time?

In the "what the data show" section, there are mistakes in the % increases. Going from 5 million to 6.3 million is an increase of (6.3/5 – 1)x100% = 26%, not 126%, and the increase from 155,000 to 577,000 is 272%, not 370%. Also, it should be pointed out that the number of unmitigated homes is rising faster than the number of mitigated homes.

T4Q1 claims that the question is not applicable. But haven't a relatively limited number of radon measurements been used to extrapolate the number of homes with elevated levels nation-wide? I'm not arguing that this extrapolation is not valid, merely that it has been done and should be acknowledged.

T4Q4 wasn't answered.

Hidy: The recommendation for inclusion needs to be considered in terms of relevance o ambient air quality.

7) Overall, this indicator:

Chinkin: _X_ Should *not* be included in ROE06 TD.

Civerolo: _X_ Should be included in ROE06 TD with the modifications identified above.

Fairley: _X_ Should be included in ROE06 TD.

Hidy: _X_ Should be included in ROE06 TD.

Comments for Group 2 Indicators

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Attachment 3: Comment Sheet for Group 2 Indicators

Topic Area: **Air**
Indicator Name: **Ozone Injury to Forest Plants**

1) To what extent do you agree with this statement:

> This indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3) Plant damage from ozone is a good indicator of pollutions effect on the environment.

Civerolo: (3) This is certainly a tool that can be used to assess ecosystem health. I'm just curious; how does one isolate the effects of ozone separate from other oxidants or acidic deposition? Perhaps a few sentences could be added to address this.

Fairley: (3) It should be pointed out that this is not a trend indicator. However, it appears that data exist to look at trends, since there are data for some sites extending back to 1994.

Hidy: (3) I agree that O3 damage to forests is a useful and appropriate metric.

2) To what extent do you agree with this statement:

> This indicator makes an important contribution[25] to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions).

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) indicator appears robust and representative.

Civerolo: (None) I would guess that this is an important indicator, but don't feel comfortable commenting.

Fairley: (3) Air pollution affects more than just human health. This indicator helps to make this point.

[25] Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.

Hidy: (3) O3 is a well known danger of forests, and the damage can be severe at high enough O3 concentrations. However, generally levels of O3 concentrations, especially for 8 hr. averages are low enough that damage can be minimized. The metric is still useful, because O2 damage is readily identified among species.

3) Please provide any additional comments, suggestions, or concerns regarding the indicator that you may have.

Chinkin: Graph does not show trends over time; need to follow standard style for all indicators.

Civerolo: Please see comment on Question #2.

Fairley: The introduction and T1Q2 says that "sites are selected using a systematic sampling grid, which is based on a global sampling design." It would be nice it this were more explicit. I assume the plots are in various national parks and forests. I am wondering because Sequoia National Park has a serious ozone problem, often experiencing the highest ozone concentrations in Central California, and exceeding the 8-hour ozone primary NAAQS on a high percentage of days. Yet it appears that ozone damage in the Pacific Coast region is low. Listing some of the parks that measurements are taken would bring this indicator home to people reading ROE2006.

To what extent are ozone concentration measurements made along-side the leaf damage evaluations?

It is unclear what the graph represents. The title says "Ozone injury to trees, 1994-2000," yet there is no indication how the time component comes in. Is the information for each site averaged over the years available for that site? Or were all the site-years combined for each region?

Hidy: [no answer provided]

Attachment 3: Comment Sheet for Group 2 Indicators

Topic Area: **Air**
Indicator Name: **Blood Cotinine**

1) To what extent do you agree with this statement:

> This indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's air and therefore useful for contributing to an overall picture of our nation's air.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Chinkin: (3) Blood cotinine is a well established measure of exposure to ETS

Civerolo: [no answer provided]

Fairley: (4) Here's another indicator that is not a trend indicator. I don't argue that it's not valid, but that the definition of indicator is too narrow.

Hidy: (2) This measure is useful as a population metric for environmental tobacco smoke—mainly indoors. While useful as an indicator of improved reductions in exposure, it seems to be a stretch to include it as a national indicator of improved air quality under the terms and conditions of the Clean Air Act.

2) To what extent do you agree with this statement:

> This indicator makes an important contribution[26] to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions).

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Chinkin: (3) indicator appears robust and representative.

Civerolo: [no answer provided]

Fairley: (4) ETS is a major air contaminant. Showing blood cotinine is an excellent measure since it relates to dosage.

[26] Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.

Hidy: (2) The indicator is only an indirect measure of exposure to tobacco smoke. There are no direct measurements in the trends in tobacco smoke concentrations indoors, or in reductions in smoking reported with the data. It's difficult to trace this health measure back to air quality per se.

3) Please provide any additional comments, suggestions, or concerns regarding the indicator that you may have.

Chinkin: Graph does not show trends over time (there is no graph); need to follow standard style for all indicators.

Civerolo: I don't feel comfortable commenting on this indicator.

Fairley: The "what the data show" section says that there's been a 70% decrease in median serum levels since 1988-91. But, actually, the data presented *don't* show that. There is only a table for 1999-2000 levels. If this comparison is valid, why not add it as a graphic?

There is no way to connect these data with health effects. It is impossible to know how to interpret these concentrations, except on a relative basis – comparing one group to another. Is there a linear dose-response curve? How many cases of cancer (or other health problems like heart disease) in non-smokers are attributable to ETS?

Hidy: If this is to be used as an ROE it would be helpful at least to include some statistics on reductions in tobacco use within the U.S. as a measure of trends in "emissions" to go along with this health indicator.

General Comments for Group 1 and Group 2 Indicators

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Attachment 4: Comment Sheet for General Questions for Group 1 and 2 Indicators

Topic Area: **Air**

1) Considering the Group 1 and 2 indicators *collectively*, do any of these indicators clearly seem to be more appropriate, adequate, or useful for evaluating our nation's air or for establishing an overall picture of our nation's air than others? Do any seem to be more important than the others for answering the question(s) they are intended to answer? (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators or if it covers an area of diminishing interest environmentally.)

Chinkin: Generally, ambient concentrations of key indicators (e.g., pollutants of known health effects – PM, ozone, benzene, mercury and indicator of how many people are being exposed) that are still at levels of concern are more important and useful than estimates (e.g. emissions or assumed surrogate indicators) and pollutants that are already reduced to levels of little or lesser concern (e.g., Pb and CO) or indicators that are important to only sub-regions of the nation.

Civerolo: In terms of emissions (Group 1, Question 1), I think that emissions of SO_2, NOx, CO, and Hg (and PM to a lesser degree) are more appropriate and useful than total VOC, Pb, and total air toxics. Emissions of SO_2 and NOx are critical for smog/particulate formation, acid deposition, and related issues. Carbon monoxide is a criteria pollutant and indicative of on-road and off-road sources. Total VOC and air toxics are lumped together and encompass many different source types and span a large range of atmospheric lifetimes, reactivities, etc. I believe that the VOC and air toxics emissions indicators would be improved if trends in one or a few representative compounds were also shown. In terms of Pb emissions, I would think that air emissions are not as important as they were 20-30 years ago.

In terms of air concentrations (Group 1, Question 1), I believe that ambient PM, ozone, and CO concentrations are the most appropriate and useful indicators, and will continue to be in the coming years. These pollutants are monitored at a large number of sites across the country, and, at least in the case of PM and ozone, there is information available at urban, suburban, and rural sites. Ambient concentrations of benzene and lead are important from a human health perspective, but may not be monitored at enough locations to be considered nationally-representative. My feeling is that the remaining "concentration of substances" indicators – days that MSAs have AQI values > 100; ambient concentrations of manganese metal compounds; and ozone and PM for US/Mexico border counties – do not add enough new information (they overlap with other indicators) or are particular to only one region of the country.

The remaining indicators for Group1, Question 1 – ozone levels over North America; concentrations of ozone-depleting substances; atmospheric deposition of mercury; acid deposition; and visibility – are all worthy of inclusion in ROE06, but I would not rank them as being clearly the most appropriate or useful. The same applies for the Group 1 Questions 2 (US

greenhouse gas emissions; atmospheric concentrations of greenhouse gases) and Question 3 (US homes above the EPA's radon action level).

Fairley: I believe the threats from global warming dwarf other environmental concerns. I am glad that trends in GHG emissions and concentrations, and also national temperature, have been included in ROE2006. I only wish that the potential ill-effects of these trends were spelled out, not to mention the connection between increasing GHG emissions and increasing temperature. Educating the public about climate change is vital. This report should make the explicit connection that climate change is the inevitable result of burning fossil fuels at the rates we are burning them. It should spell out the many impacts that climate change has already had, and the likely impacts in the future.

Most of the other indicators are either criteria pollutants or toxics. These differ by orders of magnitude in terms of their health impact today. But I would argue that even those that have been reduced to the point where only a small fraction of Americans are exposed to unhealthy levels (e.g., carbon monoxide and lead), should be included. They demonstrate that air pollution controls can work and have worked. I would argue strongly that trends be extended back to 1980 (if not earlier) unless there is a very strong argument not to. Compare the figures for trends in lead emissions (Figure 009-1), which extends back only to 1990, and lead concentrations (Figure 005-1), which extends back to 1980. Figure 005-1 is much, much more useful! The AQI > 100 indicator extends only to 1990 and it's difficult to see a trend. If it is extended back to 1980, the downtrend is obvious.

From my point of view, the weakest indicators are Ozone and PM in Border Counties and Manganese Metal Compounds. Neither of these is national in scope. It's not clear why the border indicator was included. There are lots of growth areas around the country. Data from the PM2.5 Speciation Trends Network can yield data on a number of metals on a nation-wide basis.

Hidy: O3, SO2 and CO along with visibility and acid deposition are probably least ambiguous in terms of air quality in the lower troposphere, as seen from the national public. GHG are probably the strongest measures of global pollution currently of interest.

2) Are there any additional *national-level* indicators that make an important contribution to answering one of the ROE questions in your topic area, but were not proposed for ROE06, that you would recommend? (Proposed indicators should meet the ROE indicator definition and criteria, be national in scale, be of a quality that likely would pass this type of peer review, and have data that are readily available. For any new indicators proposed, provide justification for their inclusion and list references or citations for the associated underlying data sources.)

Chinkin: A national indicator of the number of people (or fraction of population) exposed to air pollution above certain thresholds is a key measure of the nation's environmental condition. Therefore, I believe that the indicator should not be dropped as proposed by EPA. EPA's concerns can be addressed simply by re-calculating the population (or fraction of

population) exposed historically to the new 8-hour ozone standard using the archived 1-hour data, thus creating a fair judgement of the trends over time.

As you consider this question, ***please read Attachment 6***, which provides the list of air and other indicators presented in ROE03 that EPA does not intend to carry forward to ROE06, along with EPA's rationale for withdrawing them. If you disagree with EPA's rationale and feel any of these indicators should be included in ROE06, please so indicate in your response to this question, along with your rationale for why they should be included. Note: The full text and graphics for the ROE03 indicators can be viewed on-line at: http://www.epa.gov/indicators/roe/html/tsd/tsdAir.htm

Civerolo: I would recommend three additional indicators for ROE06:

1. *Ambient NO_2 (or NOx) concentrations*. Emissions of NOx was listed as a Group 1 indicator for Air, it seems to make sense that ambient concentrations should be included as well. NO_2 is a criteria pollutant and is monitored nationwide; data from hundreds of NAMS/SLAMS monitors are available from AQS. Granted, the current network is urban area-oriented, but the sampling design and monitoring plan are as valid and appropriate as CO, Pb, and the other criteria pollutants.
2. *Ammonia emissions*. Emissions of NH_3 are critical to understanding fine particulates, ecosystem eutrophication, acid deposition, and other related issues. Certainly, the uncertainties in these emissions are large, and the inventories are not as "mature" or robust as, say, those for SO_2. However, there have been recent updates to NH_3 emissions, such as the work done for the Mid-Atlantic Regional Air Management Association (MARAMA, "Development of ammonia emissions inventory for selected source categories; http://www.marama.org/visibility/Ammonia). I would guess that the uncertainties associated with mercury emissions would also be rather large, but this was listed as a Group 1 indicator.
3. *Ambient PM speciation (concentrations).* Ambient PM mass is listed as an indicator for ROE06, but the speciation of the particulate matter is crucial for human health and source apportionment. The EPA Speciation Trends Network (http://www.epa.gov/ttn/amtic/speciepg.html) monitors fine particulate species composition at (largely urban) sites across the nation, and the IMPROVE network monitors fine particulate species composition at generally rural sites at more than 100 sites as well. It is possible to obtain some PM10 speciation data from AQS as well – sulfate, nitrate, and some metals. It might be that this indicator was overlooked, since the STN data only date back to about 2000.

Fairley: A) Viewing the Table of Group 1 and Group 2 indicators, there is a glaring omission, namely the absence of exposure indicators. Simply showing trends in concentrations or emissions fails to show the seriousness of contemporary concentrations of various pollutants. ROE2003 had one such indicator, namely the number of people living in areas where air quality exceeds the various NAAQS (Exhibit I-5 in ROE2003). The argument in Attachment 6, "Because of changing populations and air quality standards,…this indicator masks actual trends in the levels of air pollutants" seems a weak argument at best. Regarding population, I presume

the argument is that since population is increasing, the number of people exposed to unhealthy concentrations would increase even if the air quality remained the same. But, this could be addressed by considering the considering the fraction of the population living in such areas, instead of the number of people. I don't understand the argument about "changing …air quality standards." All I can think of is that they mean that certain standards, e.g., the 8-hour ozone standard, didn't exist in earlier years. But there is no reason that these couldn't be computed, with a note saying that the historical comparisons are being made to see trends relative to contemporary air quality standards. In the case of PM2.5, which doesn't have a long-term record, it would still be useful to provide the fraction of people currently living in areas exceeding the standards.

One issue would be whether to consider EPA designations or actual air quality. What I'm talking about here is that designations are done on a regional basis, even if only a small fraction of the area actually exceeds the standards. For example, in the SF Bay Area, most people live in areas with ozone meeting national O3 standards but, because there are two less-populated areas that violate the standards – Livermore and Gilroy, the whole area is a non-attainment area for 8-hour ozone. An alternative is to compute this indicator on a county-by-county basis, applying the appropriate standard to each of the monitors in the county and determining if any monitor violates the standard. For example, for the 8-hour ozone standard, one would find the 4th highest 8-hour ozone values for each of 3 years, average them, and compare with the 0.08 ppm standard (applying the various data completeness requirements spelled out in the Code of Federal Regulations).

This indicator is similar to the AQI > 100 indicator, but there are several differences. First, the AQI indicator deals with the *frequency that the level of the standard is exceeded*, whereas this indicator deals with *violations of the standard*, taking into account not just the level of the standard, but also rules for how many exceedances are permissible. A second difference is that the AQI indicator gives equal weighting to each MSA with population > 500,000, whereas this indicator is population-weighted. I would say that population weighting has a more logical basis. Why the 500,000 cutoff? Why treat an MSA with 500,000 people the same as an MSA with 5,000,000 people? A third difference is that the AQI indicator lumps all criteria pollutants together, masking the large differences in how many people live in exceedance areas. For example, as Exhibit 1-5 shows, there were over 100 million people living in areas that violated the 8-hour ozone standard, compared with less than 1 million people for the CO standard.

B) There is one exposure indicator that has been computed for California air basins and would be possible on a national scale, namely estimates of per capita exposures to ozone concentrations above a certain threshold – 120 ppb, for example. Ozone data are widely monitored and ozone is relatively consistent spatially. Population data are available down to the block level. It is relatively straightforward to combine these two datasets, using inverse distance weighting to nearby ozone monitors. The result are values that represents cumulative outdoor exposures to high ozone levels. This measure has the limitation that people spend most of there time indoors where ozone levels are both lower and not necessarily correlated with outdoor. Also, people are not always at home. However, children tend to be near home much of the time (e.g., at school), and are often outside during high ozone periods.

This exposure measure could be computed for two or three time periods. Being highly volatile, I would suggest taking 3- or 5-year averages, e.g., 1980-82, 1990-92, and 2000-02. Also, the results could be presented spatially, by county.

C) I would argue that the Air Toxics Emissions indicator is almost worthless as is. Adding all toxic compounds to represent toxic trends is like trying to look at US mining trends by lumping the tonnage of gravel in with the tonnage of gold. One solution would be to weight the toxics by carcinogenic potential, but only a minority of toxics have approved carcinogenic risk numbers. Another solution would be to pick the 6-12 toxic compounds that appear to pose the greatest health risk and show trends in these individually.

D) Diesel emissions are the veritable elephant in the toxics closet. Although I'm aware of the controversy surrounding just how toxic it is, there is no question that is not healthy. I believe that the emissions inventory would contain estimates of diesel emissions trends & I would argue for the inclusion of this indicator.

E) There is a rich source of data that has not been tapped for this report, namely the PM2.5 Chemical Speciation Trends Network, which collects data on a range of chemical species in PM2.5, including higher molecular weight elements, ions, and organic and elemental carbon. The network has been in operation only a few years, but it provides data on PM2.5 composition, something not shown by other indicators. It would be interesting to see a chart showing the largest contributors (e.g., organic and elemental carbon, ammonium sulfate and nitrate, and silicon+aluminum+calcium+... to represent soil) by geographic area.

A general comment about indicator definition: The requirement that every indicator must represent a trend is too limiting.

Each of the questions that serve as the basis of ROE2006 is posed as an issue of trends. The requirement that all indicators represent a trend represents a serious limitation and, in fact, is not even met in several cases. See, for example Figure 200R-1: Average Manganese Concentrations, Figure 038-1: Total Mercury Concentrations 2003, Figure 115-I: Ozone injury to trees, 1994-2000, Blood Cotinine Level. My point is that these are useful indicators to describe the environment, but they are not *trend* indicators.

I think this issue is important because there are plans to leave out what I consider one of the most important indicators in ROE2003, namely Exhibit I-5: People living in areas with air quality above the NAAQS 2001. This is the only indicator that gives readers a sense of how the various criteria pollutants compare in terms of health impact. It shows that a large fraction of the US population lives in areas that exceed the ozone and PM NAAQS, but very few live in areas that violate the NO2, SO2, CO or lead standards.

Question 1: "What are the trends in outdoor air quality and their effects on human health and the environment?" makes questionable sense. Parsing , "their" must refer to "trends" and not "outdoor air quality", so that the question seems to be what the effect of trends on human health and the environment. But air quality standards aren't written in terms of trends, but in terms of

concentrations or risk. This is an important point. For example, there has been a strong downtrend in CO concentrations since 1980, but the effect on human health of this trend depends on what the concentrations have been. The downtrend from 1990-2000 was similar to that from 1980-1990, but the effects on human health are different, because in the 1980s the CO concentrations were higher and violated the standards in many areas, whereas, in the 1990s (although there were probably improvements in health even below the level of the standard), most areas had met the national standards so that additional reductions likely had a smaller impact on human health.

My point is that looking only at trends in concentrations and emissions lacks a clear-cut referent. In most studies of air pollution I've seen, the trend data need to be augmented with data on the status relative to air quality standards. This information was present in ROE2003 (Exhibit 1-5). Referents are lacking in the set of indicators for ROE2006.

Hidy: There are others, but the data are probably not available to support a national picture.

Comments for Group 3 Indicators

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Attachment 5: Comment Sheet for Group 3 Indicator

Topic Area: **Ecological Condition**
Indicator Name: U.S and Global Mean Temperature and Precipitation

1) To what extent do you think the indicator meets the following indicator definition:

*An "indicator" is **a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition** over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Chinkin: (4) Temperature and precipitation are basic atmospheric measurements with long histories of data collection.

Civerolo: (3) Meteorological variables such as temperature and precipitation are fairly straightforward to measure, and there are accepted techniques to deal with biases and discontinuities in these data. They also have a profound influence on air quality and acidic deposition. A relatively cool, wet year might lead to lower ozone concentrations and increased deposition loading, for example. Trends in pollutant concentrations are very dependent on the year-to-year variations in meteorology. These parameters may be directly or indirectly related to heat stress, water supply levels, incidence rates of vector-borne diseases, and many other public health issues.

Fairley: (4) The indicators of temperature and precipitation clearly meet the first part of the definition. The issue in the second part would be b) whether the trends at the sites monitored represent the nation (or world) as a whole. The set of monitoring locations appear to have been selected to minimize local influences and be representative of a large area.

Hidy: (2) The measures of continental surface air temperature change and precipitation are very coarse determinants of change in the atmosphere. They are influenced by natural fluctuations in meteorological averages, and *may be* signal of climate alteration. The records available for direct measurements are relatively short term in the U.S. compared with climatological cycles. The temperature and precipitation records in various regions are valuable records that should be maintained, but they should not necessarily be used as the sole record for indications of climate alteration.

To date the link between these measures and human health or ecological stress are problematic.

2) To what extent do you think the indicator meets each of the following indicator criteria:

a) The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (2)

b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (4)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

e) The data are comparable across time and space, and representative[27] of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (2)
Civerolo: (2)
Fairley: (4)
Hidy: (3)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Chinkin: (3)
Civerolo: (3)
Fairley: (4)
Hidy: (3)

Please explain:

Chinkin: Some uncertainty is introduced because measurement methods have become more sensitive over time and urbanization of some areas may alter the temperature or precipitation amounts on a local scale.

Civerolo: Understanding ambient levels and trends in air quality and deposition require knowledge of temperature and precipitation. These variables are measured across a fairly dense observational network with high temporal resolution. The recent trends in these parameters are presented pretty well here in terms of how they vary regionally. However, the link between temperature and precipitation and human health is complicated. Temperature alone is important for understanding heat stress, but one needs also to take into account how well certain segments of the population can acclimate better to short-term increases in temperature, and what role humidity plays too. Increased precipitation may reduce pollen levels but may be conducive to

[27] An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

more mosquitoes. Precipitation is not as simple to measure as temperature – there are issues with ice and snow collection, dependence on elevation/terrain, etc.

Fairley: [no answer provided]

Hidy: The temperature and precipitation records available in the U.S. have been useful in indexing the trends in regional climate change, and have provided a useful picture of drought patterns. However, they are less useful at this stage as the sole indicators of green house effects on climate of the U.S. These are a coarse indicator of change. If we understood better the dynamic character of radiative forcing, we could probably use better indicators of change that would be more meaningful to the state of the atmosphere.

3) Do you have any suggestions for more effective graphic presentation of the data? If yes, please describe.

Chinkin: Indicator should use same plot style as other indicators, trends over time in each region on a map of the nation.

Enlarge national figures.

Civerolo: What is actually being displayed in the time series plots? Are the light lines monthly means, for example, while the dark line the annual mean, or running mean, etc.? Please clarify.

Fairley: I like the graphics. One suggestion would be to give the Global plots the same vertical scale as the US plot. As it is, it looks like the global increase over the 20th century has been greater than for the US when, in fact, it is less.

Hidy: The graphics are a nice summary of changes in T and precip. In various parts of the contiguous US. The narrative needs to elaborate on what the message is regarding explaining this change. The narrative stops short of assigning the temperature increase to CO2 emissions. Assigning global climate alteration to changes in precipitation are even more difficult given the natural changes in climate occurring across North America. Is there an explanation why cooling is seen in the Southeast—despite very large regional increases in CO2 emissions if this change is associated with climate forcing. Given the widespread nature of the "30s drought, and later drought periods affecting the Midwest, I'm surprised that only the Southwest shows a decline in precip. In the maps showing change—what period do these maps cover?
The narrative should be explicit in interpreting the meaning of these changes. Otherwise, why include them in this ROE06.

4) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 3. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Chinkin: Figures are based on 68 out of 103 year period for inclusion in trends (why not the more typical 75% completeness criteria?).

Civerolo: These trends are reflective of fairly recent changes in temperature and precipitation, and certainly predate records of air quality. In the overall scheme of things, this is still a very short time period. Certainly, temperatures appear to have risen globally over the past century, and some of this is due to human influence. However, one cannot dismiss natural variations over thousands, hundreds of thousands, etc. that influence temperature and precipitation.

Fairley: I would like to see the introduction strengthened 1) to include connections between this indicator and the GHG indicators, and 2) to discuss in more detail what the detrimental (and beneficial) effects these temperature increases may have on the human health and the environment.

The 1st paragraph, 1st sentence of the "what the data show" section says that temperatures "rose linearly" since 1901. In fact, there has been tremendous variation & the trend appears non-linear. Why not just say that temperatures rose at an average rate of 0.06^{o}C per decade?

The 1st paragraph, 2nd sentence of the "what the data show" section says that the last 5 5-year periods were the warmest in the last 109 years "(compared to the 1961-1990 mean)." I don't understand this parenthetical comment. Why do the 5-year periods need to be compared to a long-term mean and not just to each other?

The 3rd paragraph, of the "what the data show" section says that linear regression shows a 4.5 mm/decade increase in precipitation. What are the standard error and p-value of this trend coefficient? Is this trend statistically significant?

Hidy: As noted in (3) the narrative needs to discuss carefully the graphics in the light of air quality or climate forcing. In the case of temperature, there are natural variations to consider, as well as the combination of forcing from greenhouse gases, and forcing associated with aerosols. Precipitation variations also are complex, with linkages to aerosols through both nucleation processes in clouds, shifts in droplet or hydrometeor size distributions. Precipitation also is linked with the macroscopic changes in water cycle, which has been forced by use in agriculture and urban development (land use). All of these complexities need to be touched on in the narrative to give the reader perspective on the implications of the trends in T and precip.

5) Overall, this indicator:

Chinkin: _X_ Should be included in ROE06 TD with the modifications identified above.

Civerolo: _X_ Should be included in ROE06 TD with the modifications identified above.

Fairley: _X_ Should be included in ROE06 TD.

Hidy: _X_ Should be included in ROE06 TD with the modifications identified above.